

University of Massachusetts Lowell

Division of Continuing Education



1994 - 96 Catalog of Undergraduate Studies

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The main purpose of this catalog is to provide current, reliable, detailed information about our courses, programs, support services, and facilities. Here are some suggestions for using this catalog.

- 1) Survey your program choices by referring to the Quick Reference Guide above. After selecting a particular program, turn to the page indicated to review the requirements and suggested curriculum for that program.
- 2) Select from the course categories above to review course descriptions, prerequisites/corequisites, and the number of credits.
- 3) Once you have selected courses, refer to the Continuing Education Course Bulletin (published each semester) for the latest information on course offerings and registration procedures.

For more information on admission into degree or certificate programs, turn to page 115.

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University of Massachusetts Lowell
Division of Continuing Education

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Introduction

We are pleased to welcome you to the many programs of the University of Massachusetts Lowell Division of Continuing Education. With over 65 years of service to adult learners, primarily in Massachusetts and New Hampshire, the Division of Continuing Education attracts and serves one of the largest student populations in northern New England, providing approximately 25,000 enrollments annually in a variety of educational programs.

As we approach the year 2000, revolutionary changes in the workplace are producing a major impact on the way we live, the way we work, and the quality of our lives. Fueled by global competition, advancing technology, and a corporate restructuring that has virtually wiped out several layers of middle management, workplace upheavals are stimulating dramatic increases in the number of adult students returning to the classroom.

In response to these workforce transformations, adults are retooling everywhere, either at their companies' request or upon their own initiative. Students are enrolling in degree and certificate programs, as well as taking individual, open-enrollment courses to help them survive in economically hard times.

Now, more than ever, the nation's continuing education organizations are assuming significantly larger roles in satisfying the learning and training needs of working adults. At UMass Lowell, students already enjoy more access, more choices than ever before, and can expect more opportunity in the coming years. We see this reflected in our degree and certificate programs, our large selection of new courses, our expanded counseling services, and our exciting array of professional development seminars and special programs.

We invite you to explore the credit course offerings in this catalog. If you have questions about any of our credit and noncredit programs, please feel free to contact our staff. We wish you a pleasant and rewarding experience at the University of Massachusetts Lowell.

Continuing Education Administration:

Dirk Messelaar
Janet Sawyer
Catherine A. Kendrick
Pauline Carroll

About the University

The University of Massachusetts Lowell is publicly supported by the Commonwealth of Massachusetts, and offers degree programs at all levels through the doctorate. The University occupies 35 buildings on three campuses (North, South, and West) and presently has over 500 faculty members and a student enrollment of more than 10,000. It is comprised of six colleges, a graduate school and the Division of Continuing Education, which serves an additional 4,000 students.

On September 1, 1991 the University of Lowell became part of the University of Massachusetts system. The new system is comprised of five campuses: Boston, Amherst, Lowell, Dartmouth, and Worcester.

The University of Lowell was formed in 1975 through a merger of Lowell State College and Lowell Technological Institute. Each of these institutions was established in the 1890's, Lowell State College as a teacher's college and Lowell Technological Institute to prepare workers for the textile industry. Lowell State College was chartered in 1894, became a four-year institution in 1932 and, in 1960, added non-teaching programs and a Liberal Arts curriculum. The College granted degrees in education, health professions, liberal arts, sciences and music.

From the time of its origin in 1895 as a proprietary textile school, Lowell Technological Institute provided educational programs of an applied and practical nature. The control of the school was transferred to the state in 1918, and in 1928 it was granted collegiate status. In 1953, it became a multi-purpose technological institute. Prior to its merger with Lowell State College, the Institute phased out its textile curricula; it extended its offerings in engineering, technology, science, business administration and industrial management, and it received authorization to offer doctorate degrees.

Mission of the University

Although undergraduate program emphasis is in business, engineering, health, music and science, the University strongly believes in the values of a liberal arts education for intellectual development and as a major component of professional preparation. Graduate program emphasis is in areas where there are strong regional needs or where the University possesses superior resources.

The University is committed to the promotion of scholarly research and creative, artistic achievement. Recognizing its role as a public institution, the University supports active involvement in community service through instruction, research, consulting, cultural events and the Division of Continuing Education. Finally, the University recognizes its responsibility for implementing the principles of equal opportunity and affirmative action, and ensures that all students and employees are guaranteed the benefits of a just and equitable system.

One of the University's four central goals identified by Chancellor Hogan's Commission to Study Academic Organization and outlined in its Final Report (1991) is: "To expand the University's relationship to the community as an educational resource and regional center for lifelong learning." The role of Continuing Education is seen as critical not only to this proximate goal but also to the University of Massachusetts Lowell's long term commitment:

"Providing opportunities for lifelong learning is an essential component of Lowell's mission. To that end, the Lowell campus will expand and intensify its interaction with its wider community, basing that broadened relationship on a spirit of lively academic inquiry. The campus will thus become an educational, economic and cultural resource to which citizens turn, not once, but repeatedly, to enhance their lives and the lives of others." (UMass Lowell Mission and Strategic Goals Statement, 1992)

About Continuing Education

The Division of Continuing Education at the University of Massachusetts Lowell, with over 21,000 credit and 5,000 noncredit enrollments annually, is one of the largest continuing education units in New England and the largest and most comprehensive among the five campuses in the state university system. It is also one of the oldest continuing education units in the state, founded in 1928 for the purpose of providing opportunities for growth and advancement for people working in the textile and other industries in the Lowell area. This mission has essentially stayed the same: to provide access and opportunity for people who seek professional development or personal enrichment. In an era of changing technologies, global competition, and a difficult economy, we help people get and keep jobs, as well as progress in their careers. In general, we seek to foster a better-educated, more enlightened population through lifelong learning.

The Division of Continuing Education attracts people of all ages, cultural and educational backgrounds. The Continuing Education student population includes transfer students from area community colleges, people returning to school and individuals who work full time in business, government, hospitals, schools and other institutions.

History

The development of the Division of Continuing Education at UMass Lowell parallels the growth of Lowell Technological Institute. Beginning in 1928, courses for textile workers were offered in the afternoon and evenings to teach industrial and commercial applications. In 1953, when Lowell Tech became a multi-purpose technological institute, it offered an evening and summer school to help meet the needs of part-time students and college students seeking to accelerate course work. With the creation of the University of Lowell in 1975, offerings in education, health professions, liberal arts, sciences and music were added to the Lowell Tech offerings.

Currently, the Division of Continuing Education has four distinct service areas: undergraduate degree and certificate programs, noncredit courses in Community Education, Special Programs and Summer Session, during which graduate, undergraduate and noncredit programs are offered.

Academic Degrees and Certificate Programs

The Division of Continuing Education provides college credit courses and degree and certificate programs to a variety of learners. Students enroll in programs to acquire extensive practical background and skills, for professional advancement, to facilitate career changes, and for personal enrichment and satisfaction. University faculty and experienced professionals teach a wide spectrum of credit courses leading to associate's and bachelor's degrees. Continuing Education sets policies and schedules with the working person in mind. Career oriented curricula in many fields are available on a part-time, evening basis.

Degree and certificate programs available through the Division of Continuing Education:

College of Arts & Sciences Fields of Study	Associate's Degrees	Bachelor's Degrees	Certificate Programs
Applied Chemistry	■	■	
Applied Chemistry: Coatings Option		■	
Applied Chemistry: Biotechnology Option	■	■	
Applied Chemistry: Hazardous Waste Option	■		
Applied Mathematics	■	■	
Applied Mathematics: Computer Mathematics Option	■	■	
Information Systems	■	■	
Criminal Justice	■	■	
Criminal Justice: Paralegal Option		■	
Liberal Arts Degree - Concentrations in Psychology, Sociology, History, and Political Science		■	
Computer Proficiency			■
Data/Telecommunications			■
Paralegal Studies			■
Security Management			■
Technical Writing			■
UNIX			■

The James B. Francis College of Engineering Fields of Study	Associate's Degrees	Bachelor's Degrees	Certificate Programs
Civil Engineering Technology	■	■	
Civil Engineering Technology: Environmental Option		■	
Civil Engineering Technology: Surveying Option	■		
Civil Engineering Technology: Water Treatment Option	■		
Civil Engineering Technology: Wastewater Treatment Option	■		
Electronic Engineering Technology	■	■	
Mechanical Engineering Technology	■	■	
Mechanical Engineering Technology: Manufacturing Option		■	
Environmental Technology			■
Manufacturing Technology			■
Plastics Engineering Technology			■
Quality Assurance			■
Wastewater Treatment			■
Water Treatment			■

College of Management Fields of Study	Associate's Degrees	Bachelor's Degrees	Certificate Programs
Accounting	■		■
Banking	■		■
Management	■		
Purchasing Management			■

Community Education Program

A wide range of noncredit courses is offered year round through the Community Education Program. Reasonably-priced courses are available in fields such as art, dance, music, business, careers, finance, crafts, fitness, foreign languages, history, exam preparation, home repair, and design. Three unique programs: English as a Second Language, the PC/Mac User Institute, and the Center for Entrepreneurship have been developed for individuals seeking professional skill enhancement. The College for Young Adults program allows students ages 13 to 17 to take noncredit courses specially developed around their interests.

Complete listings of the Community Education courses, including course descriptions and schedules, are published each semester in the Continuing Education bulletin. Community Education is located at the Mogan Cultural Center, 40 French Street, adjacent to Boardinghouse Park. Students may register for these courses by phone, mail or in person through the Office of Enrollment Services.

Summer Session

The Division of Continuing Education operates a full summer schedule, providing undergraduate as well as graduate courses during day and evening hours. Individuals enroll in the University Summer Session to accelerate their program of study, make up course work, facilitate career promotions or for personal enrichment.

Registration for any summer session may be made by phone, mail or walk-in procedures. The summer bulletin, which lists all the courses and special programs offered, is available by calling the Office of Enrollment Services at (508) 934-2480. Summer dormitory housing may be arranged for those who wish to stay on campus.

Winter Intersession

A number of highly-concentrated courses are offered during January, prior to the start of Spring classes. Students can earn college credit and accelerate their educational program during Winter Break by taking day or evening courses, Monday through Saturday. For a Winter Intersession Course Bulletin, call the Office of Enrollment Services at the number above.

Special Programs

The Office of Special Programs manages over 150 seminars and conferences annually. These programs for working professionals range from one day seminars to large conferences in a wide range of subject areas including: production management, manufacturing, quality, marketing, environmental science, toxic use reduction, wastewater treatment, work environment, engineering, plastics, and computer science. Most seminars are taught by University faculty and highlight their research and academic specialties. This office administers credit and noncredit, on-site courses or seminars at companies around the country. In addition it manages a plastics and manufacturing engineering seminar series at Brunel University in London, England, as well as a satellite campus at the Woods Hole Oceanographic Institute in Falmouth, Massachusetts.

Academic Accreditation and Professional Memberships

The University of Massachusetts Lowell is an accredited member of the New England Association of Schools and Colleges. Accreditation indicates that the University is recognized and approved by regional and national associations concerned with the quality of higher education and it assures that study undertaken here has transfer value to other accredited institutions of higher education.

Professional programs at the baccalaureate level also are accredited by the following national associations:

Accreditation Board for Engineering and Technology
American Assembly of Collegiate Schools of Business
American Physical Therapy Association
National Accrediting Agency for Clinical Laboratory Sciences
National Association of Schools of Music
National Council for the Accreditation of Teacher Education
National League for Nursing

The following programs offered through the Division of Continuing Education are accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (TAC/ABET):

Civil Engineering Technology
Electronic Engineering Technology
Mechanical Engineering Technology

Additionally, specific programs have been reviewed by the following associations to ensure compliance with applicable professional standards:

American Chemical Society
Interstate Certification Compact

The University is also a member of the following associations:

American Association of Colleges for Teacher Education
American Association of Colleges of Nursing
American Council on Education
Association for Continuing Higher Education
Association for State Colleges and Universities
College Entrance Examination Board
Council of Colleges of Arts and Sciences
National Association of Summer Sessions
National Association of State Directors of Teacher Education and Certification
National University Continuing Education Association
New England Board of Higher Education

Course Descriptions

Each description consists of at least three components:

- course number and title
- course description
- academic credits

Where relevant, the following may also appear:

- any prerequisite(s) and/or corequisite(s)
- area distribution is indicated if the course meets Human Values or Area I, II, or III core requirements

For example:

83.102 Life Science II

Emphasizes systems structure and function. The cellular organization of plants and animals leads into physiological processes of higher organisms with great emphasis on humans. Among topics considered are nutrition and digestion, cellular metabolism, circulation, respiration, excretion, nervous and skeletal-muscular systems. Also considered are the chemical interactions of these systems with immunity, hormonal and reproductive processes. 3 credits. Corequisite: 83.104. Area III.

Course numbering: The two-digit course prefix denotes the department which offers the course. (See the Quick Reference Guide at the front of this catalog for the department numbers.) The first digit after the decimal point indicates the general level of the course: .100 = freshman level, .200 = sophomore level, .300 = junior level, and .400 = senior level.

Accounting

60.201 Accounting/Financial

Presents a comprehensive, detailed exposure to basic accounting theory. Beginning with the accounting equation, the student is introduced to the accounting cycle, preparation of the statement of financial position and the income statement, accounting for the assets, liabilities, and stockholders' equity of the firm, and cash flow and financial statement analysis. 3 credits.

60.202 Accounting/Managerial

Examines the use of accounting systems for managerial decision making. Budgeting, forecasting, and cost accumulation systems which relate to manufacturing firms will be studied. 3 credits. Prerequisite: 60.201.

67.101 Accounting Principles I

Presents a comprehensive and detailed exposure to basic accounting theory. Beginning with the accounting equation, the student is introduced to the accounting cycle, preparation of the Statement of Financial Position and the Income Statement. Accounting for the assets of a firm will also be discussed. 3 credits.

67.102 Accounting Principles II

Emphasizes accounting for corporations, treatment of stockholders' equity, earnings and dividends. Students will examine the Statement of Changes in Financial Position, cash flow causes and effects, as well as financial statement analysis. 3 credits. Prerequisite: 67.101.

67.203 Intermediate Accounting I

Examines the generally accepted accounting principles relating to the preparation of financial statements. The student will study the valuation and disclosure problems associated with the assets of the firm. 3 credits. Prerequisite: 67.102.

67.204 Intermediate Accounting II

Continues the in-depth study of the valuation and disclosure problems associated with corporate liabilities and stockholders' equity. Emphasis is placed on the opinions of the Accounting Principles Board and Financial Accounting Standard Board. 3 credits. Prerequisite: 67.203.

67.205 Advanced Financial Accounting

Explores theoretical and practical problems in accounting for large, multi-corporation business entities. Consolidation, mergers and home office/branch accounting each receive in-depth study. 3 credits. Prerequisite: 67.204.

67.206 Cost Accounting

Examines the manufacturing function from the view of the cost accountant. Managerial control of the elements of product costs will be studied with an emphasis on cost accumulation systems both historical and estimated. 3 credits. Prerequisite: 67.102.

67.207 Auditing

Examines the purposes of financial auditing and operations auditing. The following topics will be discussed in detail: auditing, standards, professional ethics, legal responsibilities, internal control, audit evidence, financial statements, disclosures, audit reports, management advisory services, and internal auditing. 3 credits. Prerequisite: 67.204.

67.209 Federal Income Taxes

Deals with the basic rules and regulations of the Internal Revenue Code as it affects the individual and the corporation. An understanding of the code is developed through lectures, assigned readings and research. Upon completing this course, students will be able to find solutions to a wide variety of tax problems. 3 credits. Prerequisite: 67.102.

67.280 Accounting for Not-for-Profit Institutions

Examines financial accounting methods, principles and systems, as related to state, county and local governments, colleges and universities, and hospitals. While fund accounting concepts provide the general framework of the course, expenditure controls are given particular attention through an examination of appropriation and encumbrance accounting. 3 credits. Prerequisite: 67.102.

Art

70.251 Visual Design I

A study of design principles and how they articulate structure, space and form. The development of visual ideas that relate to painting, sculpture, graphic arts and architecture will also be covered. 3 credits. Area II.

70.255 Drawing I

Provides a foundation in basic drawing concepts using a variety of media and approaches. The emphasis is on realism and its application to the realm of ideas. A wide range of assignments are given to develop graphic expression. 3 credits. Area II.

70.271 Painting I

Presents oil painting techniques as vehicles for serious creative expression. A variety of assignments will be given to help the student gain proficiency in the use of color technique and subject matter. 3 credits.

70.281 Ceramics I

Introduces the student to the basic hand building techniques, wheel throwing and ceramic sculpture. The course will also examine clay, the material, glaze techniques and firing processes. 3 credits.

70.297 Studio Workshop

Presents a study of studio problems in visual structures and organization, as well as an exploration of various media and techniques. Topics will vary. This course may be repeated. 3 credits.

79.101 Art Appreciation

Introduces the student to the technical, aesthetic and historical aspects of architecture, sculpture and painting. An analysis of the visual elements used in fine art such as color, line, shape, texture, and value is developed through slide lectures, museum visits and assigned readings. Emphasis is placed on modes of representation, styles, media, technical procedures, and principles of design. 3 credits. Area II.

79.203 Survey of Art I: Prehistoric to Medieval Art

Surveys the major Western arts from earliest time to the Middle Ages presented chronologically. Emphasis is placed on the changing nature of style and content within sequential cultural contexts. The aim of the course is to introduce the student to basic critical and art historical methods. 3 credits. Area II.

79.204 Survey of Art II: Renaissance to Modern Art

Surveys the major Western arts from the Renaissance to the 20th century presented chronologically. Emphasis is placed on the changing nature of style and content within sequential cultural contexts. The aim of the course is to introduce the student to basic critical and art historical methods. 3 credits. Area II.

79.221 Twentieth Century Art

Studies American and European movements in painting, sculpture and architecture from 1900 to the present. Emphasis is placed on Fauvism, Cubism, Expressionism, Surrealism, International Style, Pop, Op Art, Minimal Art, Photorealism, and Post-Modernism. 3 credits.

79.231 Greek and Roman Art

Studies Greek painting, sculpture and architecture from the Cycladic to the Hellenistic period. An examination of Roman Art from the Etruscan age to the beginning of Christian art is also presented. Emphasis is placed on the art of the Greek classical period and the Roman Empire. 3 credits. Area II.

79.340 Women and Art

Investigates the various ways women have been portrayed in the visual arts from antiquity to the present. A chronological examination of selected female artists and their milieu from the Middle Ages to the twentieth century. 3 credits. Prerequisite: 79.101 and/or 79.203, 79.204 or permission of instructor.

Banking

Banking courses are not eligible as Accounting or Management electives.

69.101 Principles of Banking

Touches on nearly every aspect of bank functions, including a comprehensive introduction to banking in today's economy. Discussions on specific topics are presented in an easily accessible form. The language and documents of banking, check processing, teller functions, deposit function, trust services, bank bookkeeping and bank loans and investments are some primary topics. The course ends with a discussion of the bank's role in the community. 3 credits.

69.104 Analyzing Financial Statements

Provides students with tools and techniques needed for the evaluation of financial condition and operating performance of a modern business enterprise. The course is divided into four parts: Financial Statement Analysis and Accounting, Financial Statements and Business Funds Flow, Tools of Financial Statements Analysis, and the Technique of Financial Statement Analysis. 3 credits. Prerequisite: 67.102.

69.105 Consumer Lending

Emphasizes the pragmatic "how-to" details of installment credit. Topics include: principles of credit evaluation, open-end credit, marketing bank services, collection policies and procedures, legal aspects, financial statement analysis, direct and indirect installment lending, leasing and other special situations, installment credit department management, insurance rate structure, and yields. 3 credits.

69.106 Real Estate Finance

Provides a background in the varied real estate mortgage credit operations of commercial banks. This course treats the main areas of real estate by concentrating on the following broad areas: 1) the manner in which funds are channeled into the mortgage markets; 2) the financing of residential property; 3) the financing of special purpose property; and 4) the administrative tasks common to mortgage departments. 3 credits.

69.107 Bank Investments

Explains the nature of the more important bank investments and demonstrates the relationship of investment management to other functional areas of the bank. This course also discusses the factors that affect investment strategies and decisions. Emphasis throughout is on the fundamental principles with which investment personnel should be familiar: the nature of risk, liquidity and yield; how each is measured; and how they are related. 3 credits. Prerequisite: 69.101.

69.109 Marketing for Bankers

Presents marketing as a broad concept. The course deals with concepts and philosophies of marketing including: information, research and target, the marketing mix (product strategy, distribution strategy, advertising and sales promotions, personal selling, pricing strategy), and the methods of market planning. 3 credits.

69.114 Branch Banking Series

(formerly Retail Banking)

Shows how to perform more effectively as a staff leader, financial expert, and sales manager using accepted management principles in the banking environment. The series consists of three separate mini-courses tailored to those managing or preparing to manage human and financial resources in today's fast-paced banking world. The courses are Retail Management, Sales Management, and Financial Performance of Banks. 3 credits.

69.116 Commercial Bank Management

Provides a complete introduction to the handling of day-to-day bank activities. Examples include: the formulation of objectives and policies; the management of assets and liabilities; the sources and uses of funds; the administration of deposits; loans and other investments; and the short-term management of funds. This class also incorporates case studies to aid the student in acquiring bank management skills. 3 credits. Prerequisite: 69.101.

69.117 Law and Banking: Principles

Serves as a banker's guide to law and legal issues with special emphasis on the Uniform Commercial Code. This course includes up-to-date summaries of law pertaining to contracts, real estate and bankruptcy. It also contains a complete chapter on the legal implications of consumer lending. A comprehensive glossary of legal terminology related to banking and commercial transactions is included. 3 credits.

69.118 Law and Banking: Applications

Provides an introduction to the laws pertaining to secured transactions, letters of credit and the bank collection process. This course also discusses check losses and a broad range of legal issues related to processing checks. The material on secured transactions contains up-to-date summaries of the laws related to collateral, perfection and default. Interesting case studies are used to illustrate important legal points related to banking practices. 3 credits. Prerequisite: 69.117.

69.119 Commercial Lending

Provides entry-level commercial loan officers with the knowledge and skills to service the vital needs of corporate clients. The course emphasizes: organization of commercial lending operations, role of commercial lending in bank profitability, loan interviewing and credit investigation, loan documentation, administration, and closing, and preventing and resolving problem loans. 3 credits. Prerequisite: 67.102.

69.127 Financial Planning

Addresses the perspectives, principles, and practices of financial planning in an understandable, step-by-step format. It will enable students to become more sensitive to customers' financial planning goals and objectives. This course will develop your understanding of the comprehensive process that looks at a customer's objectives. 3 credits. Limited to Banking majors or Certificate candidates.

Biological Sciences

81.111 Principles of Biology I

Introduces topics such as the chemical and physical basis of life, its evolution, diversity, distribution and interrelationships of life forms. The central theme of genetic replication, translation, expression and selection will be emphasized as a unifying principle which determines and integrates structure and function at the cellular, individual population and community levels of organization. Designed for those students who intend to pursue career options in the biological sciences, biotechnology or related areas such as medicine, biomedical research, radiological sciences or environmental sciences. It is the first semester course of a two semester sequence. 3 credits. Corequisite: 81.113.

81.112 Principles of Biology II

Serves as a continuation of the 81.111/81.112 sequence for those students who intend to pursue career options in the biological sciences or related professional areas such as medicine, biomedical research or environmental sciences. Molecular energy exchange in organisms (photosynthesis and respiratory metabolism), the common functional needs of support, locomotion, nutrition, internal communication and the maintenance of homeostasis are considered. Control and regulation of organisms at levels beyond the individual are considered through discussions of population and community ecology. 3 credits. Prerequisite: 81.111. Corequisite: 81.114.

81.113 Principles of Biology I Laboratory

Presents a series of field trips and laboratory exercises designed to introduce the student to concepts of the distribution and maintenance of life. Specific consideration is given to the diversity and organization of local ecosystems; the continuation of life is considered through exercises covering mitosis, meiosis, genetics and evolutionary biology. 1 credit. Corequisite: 81.111.

81.114 Principles of Biology II Laboratory

Provides laboratory experiments, analyses, and dissections designed to introduce the student to biological techniques and processes at the sub-cellular, cellular and organ systems levels. 1 credit. Corequisite: 81.112.

81.215 Introduction to Marine Biology

Introduces the marine environment with major consideration given to the biological and ecological aspects. Emphasis is on the flora and fauna of New England. 3 credits. Corequisite: 81.217.

81.217 Introduction to Marine Biology Laboratory

Emphasizes the material covered in 81.215 using a series of laboratory exercises and field trips. 1 credit. Corequisite: 81.215.

81.252 Physiology

Presents a comprehensive study of the fundamental mechanisms governing mammalian physiology. The role of cell physiology in determining systemic functions and coordinating biological control systems will be emphasized. Maintenance of homeostasis will be discussed in terms of biochemical, cytological, anatomical and physical principles. 3 credits.

81.320 Botany

Serves as an introduction to the study of the plant kingdom dealing with the structure, function and diversity of plants with an emphasis on seed plants. The physiology, morphology, and taxonomy of plants is emphasized. 3 credits. Corequisite: 81.322.

81.322 Botany Laboratory

Emphasizes material covered in 81.320 using field and laboratory exercises. 1 credit. Corequisite: 81.320.

81.347 Human Nutrition

Emphasizes fundamental physiological and biochemical principles of human nutrition. Students will have an opportunity to compare their present dietary practices with recommended dietary allowances, goals and guidelines. Nutrient excesses and inadequacies during various stages of the life cycle (pregnancy, infancy, childhood, adolescence, adulthood, old age) will be considered. Current concepts and controversies in nutrition research, surveys, and methods will also be evaluated. 3 credits. Prerequisite: 81.111 or permission of instructor.

81.419 Principles of Biochemistry I

Studies the structure and properties of proteins, carbohydrates, and lipids which combined with a discussion of elementary enzymology allows for detailed descriptions of several important degradative and biosynthetic pathways, their integration and regulation. Throughout the course, emphasis is on methods and practical application of fundamental information to the solution of problems of current biomedical interest. 3 credits. Prerequisite: 84.221. Recommended: 84.344.

83.101 Life Science I

Presents environmental and organismal structural interrelationships and relates these to the chemical evolutionary basis of life. 3 credits. Corequisite: 83.103. Area III.

83.102 Life Science II

Emphasizes systems structure and function. The cellular organization of plants and animals leads into physiological processes of higher organisms with great emphasis on humans. Among topics considered are nutrition and digestion, cellular metabolism, circulation, respiration, excretion, nervous and skeletal-muscular systems. Also considered are the chemical interactions of these systems with immunity, hormonal and reproductive processes. 3 credits. Corequisite: 83.104. Area III.

83.103 Life Science Laboratory I

Concerned with experimentation and interpretation of some of the concepts of Life Science I. 1 credit. Corequisite: 83.101. Area III.

83.104 Life Science Laboratory II

Involved with experimentation and interpretation of some of the concepts of Life Science II. 1 credit. Corequisite: 83.102. Area III.

83.123 Nutrition and Disease

Serves as an interdisciplinary, survey course for students not majoring in Biology which deals with human nutrition as it relates to various chronic disease states. Methods of detection and treatment of the disorders will be considered as well as general concepts of health promotion/disease prevention. Specific topics covered include the role of nutrition in: heart disease, diabetes, alcoholism, obesity, senility-geriatrics, gallbladder disease, cancer, anorexia nervosa-bulimia, and pregnancy. 3 credits. Area III.

Chemical Engineering

10.347 Elements of Thermodynamics and Heat Transfer

Studies the development of the first and second laws of thermodynamics. Ideal gases. Properties of substances. Entropy, availability and lost work. Steam cycles, gas power-cycles, and vapor-compression refrigeration. Dimensionless parameters. Heat transfer by: steady state conduction, convection and radiation. For Civil Engineers, Electrical Engineers and Industrial Management majors. 3 credits. Prerequisites: 92.231, 95.144. Corequisite: 10.310†. (Offered in summer only)

Chemistry

84.101 Applied Chemistry for the Non-Scientist

Provides an understanding of basic chemical principles—atomic structure, bonding and interparticle forces, physical and chemical properties of matter—through hands-on examination of matter and the application of principles to understanding the chemistry of current issues (e.g. nuclear chemistry, resources, pollution, food and drugs) and the analysis of problems dealing with these issues. 3 credits. Area III.

84.111 General Chemistry I

Provides a one semester survey of inorganic chemistry: the structure and properties of matter, chemical reactions, stoichiometry, gas laws, solution chemistry, kinetics, equilibrium, and acid-base chemistry. Required for Nursing students. 3 credits. Corequisite: 84.113.

84.112 General Chemistry II

Surveys the basic principles of organic chemistry and biochemistry with emphasis on biochemical aspects of carbohydrates, lipids, proteins and nucleic acids. Various metabolic pathways are also emphasized. Primarily for nursing majors. 3 credits. Prerequisite: 84.111 or permission of instructor. Corequisite: 84.114.

84.113 General Chemistry Laboratory I

Requires experiments on the principles covered in 84.111. 1 credit. Corequisite: 84.111.

† Offered through the day school. See UMass Lowell's Undergraduate Catalog for course description.

84.114 General Chemistry Laboratory II

Uses laboratory experiments designed to illustrate the principles discussed in 84.112. 1 credit. Prerequisite: 84.111 and 84.113, or permission of instructor. Corequisite: 84.112.

84.121 Chemistry I

Provides an introduction to the basic concepts of chemistry through classroom discussions and demonstrations. Topics include chemical calculations, atomic structures, the periodic table, basic bonding theory, solutions, liquids and gases. 3 credits. Restricted to science, engineering, and engineering technology majors. Corequisite: 84.123.

84.122 Chemistry II

Serves as a continuation of 84.121. Topics include thermodynamics; kinetics, acids and bases; an introduction to organic chemistry; chemical equilibrium; precipitation reactions; and electrochemistry. 3 credits. Restricted to science, engineering, and engineering technology majors. Prerequisite: 84.121 and 84.123. Corequisite: 84.124.

84.123 Chemistry I Laboratory

Studies the chemical principles and chemical transformation that is coordinated with topics considered in 84.121. Some of the more important reactions of elements, oxides, acids, bases and salts are examined. Other topics include chemical separation, purification, preparation of inorganic salts, quantitative determinations dealing with the formula of a compound, gas laws, and colligative properties. Careful techniques and precise measurements are stressed. 1 credit. Restricted to science, engineering, and engineering technology majors. Corequisite: 84.121.

84.124 Chemistry II Laboratory

Serves as a continuation of the laboratory study begun in 84.123 that is coordinated with topics of 84.122. Topics include: thermochemistry, kinetics, spectroscopy, titration, pH, equilibrium reaction and constant. Some aqueous solution reactions and organic reactions are examined. Accurate measurements and precise instrumental and apparatus operation are expected. 1 credit. Restricted to science, engineering, and engineering technology majors. Corequisite: 84.122.

84.221 Organic Chemistry I

Studies the basic principles and reactions which characterize the chemical behavior of carbon compounds. Nomenclature, reactions, reaction mechanisms, and

stereochemistry will be covered. Required for Chemistry majors. 3 credits. Prerequisites: 84.122 and 84.124. Corequisite: 84.227 or 84.229.

84.223 Principles of Organic Chemistry I

Discusses structure, classification by functionality, nomenclature, synthesis and reactions as well as mechanisms of reactions of organic compounds. 3 credits. Prerequisite: 84.122. Corequisite: 84.225 or permission of coordinator.

84.224 Principles of Organic Chemistry II

Serves as a continuation of 84.223. 3 credits. Prerequisite: 84.223. Corequisite: 84.226 or permission of coordinator.

84.225 Principles of Organic Chemistry Laboratory I

Provides laboratory work that is scheduled to accompany topic presentations in the lecture (84.223) and will be devoted to product separation and purification techniques, methods of synthesis of important compounds and instrumental analytical techniques. 1 credit. Corequisite: 84.223.

84.226 Principles of Organic Chemistry Laboratory II

Serves as a continuation of 84.225. 1 credit. Prerequisite: 84.225. Corequisite: 84.224.

84.227 Organic Chemistry Laboratory I

Provides laboratory work designed to emphasize the techniques of organic synthesis and the use of instrumentation for identification and characterization of organic compounds. Required for Chemistry majors. 2 credits. Prerequisite: 84.124. Corequisite: 84.221.

84.229 Organic Chemistry Laboratory IA

Reviews techniques, skills and heuristic approaches in the synthesis, purification, and identification of organic compounds. IR, GC, and NMR instrumental methods are included. 1 credit. Corequisite: 84.221.

84.314 Analytical Chemistry II

Introduces modern instrumental methods of chemical analysis. Topics to be discussed include ultraviolet, infrared nuclear magnetic resonance, emission and atomic absorption spectroscopy. Mass spectrometry, chromatography, thermal and electrochemical methods of analysis will also be covered. 3 credits. Prerequisites: 86.122, 99.133. Corequisite: 84.316.

84.316 Analytical Chemistry Laboratory II

Presents laboratory experiments designed to complement the coverage of topics in 84.314. 2 credits. Prerequisite: 86.122. Corequisite: 84.314.

84.334 Advanced Inorganic Chemistry

Introduces modern theories of atomic structure and chemical bonding with emphasis on physical chemical principles and properties. Considerable time will be spent on coordination compounds including topics such as descriptive chemistry, biochemical importance and ligand field theory. 3 credits. Prerequisite: 84.345.

84.344 Physical Chemistry I

Covers basic physical chemical topics: laws of thermodynamics, solutions, chemical and phase equilibria, electrochemistry, kinetics, atomic and molecular structure. 3 credits. Prerequisite: 92.231 or 92.225. Corequisite: 86.355.

84.345 Physical Chemistry II

Serves as a continuation of 84.344. 3 credits. Prerequisite: 84.344. Corequisite: 84.347.

84.347 Physical Chemistry Laboratory II

Provides laboratory work designed to exemplify the principles of chemical kinetics, equilibrium and spectroscopy. 1 credit. Corequisite: 84.345.

84.352 Chemical Safety

An in-depth study of the safe handling practices, toxicity, storage, and disposal of a wide range of chemical substances. Many of the problems found in the laboratory and in industry today are discussed, including shipping, handling and related government regulations. 3 credits. Prerequisites: 84.224, 84.345.

86.121 Analytical Chemistry A

Discusses the principles and calculations of gravimetric and volumetric analysis. Material is presented in class and laboratory format. 3 credits. Prerequisites: 84.122, 92.115.

86.122 Analytical Chemistry B

Presents advanced concepts in wet methods of analysis in classroom and laboratory format. 3 credits. Prerequisite: 86.121.

86.131 Environmental Chemistry I

(formerly 20.225 Water Chemistry I)

Emphasizes basic chemical theory. Reactions and equations are presented, along with an introduction to the structure and character of water, its impurities and the chemical treatment schemes that have been devised to deal with them. 3 credits.

86.132 Environmental Chemistry II

(formerly 20.226 Water Chemistry II)

Serves as a continuation of 86.131. The course covers specific water and wastewater treatment practices, such as chlorination, coagulation, filtration and absorption, with a focus on analytical techniques for the particular parameters of interest. Wet chemistry as well as instrument methods are discussed and demonstrated during lab sessions that complement the lecture material. 3 credits. Prerequisite: 86.131.

86.341 Introduction to Biotechnology

Addresses the basic concepts involved in the field of biotechnology and the "new medical environment". Every day we hear about an advance, our understanding of a disease such as cancer, AIDS, cystic fibrosis or an article about how the rapid increase in our knowledge of thousands of human genes is leading to new forms of disease diagnosis and therapy (The Genome Project). The information, training and vocabulary necessary to work in this new Massachusetts industry will be extensively covered. Some of the topics discussed will be: gene cloning strategies (*Jurassic Park*), retroviruses, and an understanding of how biological information is stored, transmitted and used by cells. Basic chemistry and an introduction to organic chemistry will be useful. 3 credits. Corequisite: 86.343.

86.342 Principles of Biotechnology II

Serves as a continuation of 86.341. The actual development of analytical methodology will be presented as well as the construction of testing kits and bulk products. The chemistry involved in these processes will be covered extensively. There will also be an emphasis on the ability to follow "Good Manufacturing Practices", GMP, and the need to document the commercial process. 3 credits. Prerequisite: 86.341. Corequisite: 86.344.

86.343 Biotechnology Laboratory I

Introduces the student to the basic operating procedures of a modern Biotechnology laboratory. The experiments will train the individual in the procedures of protein determination, enzyme analysis and kinetic assays as well as providing them with experience in using spectroscopic techniques that are integral to antibody assays such as the ELISA assay and Western Blot Techniques. The course will introduce the student to tissue and cell culture techniques and the isolation of proteins and cell synthesis products from extracellular matrices. 2 credits. Corequisite: 86.341.

86.344 Biotechnology Laboratory II

Serves as a continuation of Biotechnology Laboratory I. 2 credits. Prerequisite: 86.343. Corequisite: 86.342.

86.352 Chemical Applications

Provides a study of the chemical principles applied to one or more areas of industrial technology. 3 credits. Prerequisite: 84.345.

86.355 Experimental Physical Chemistry

Provides laboratory work designed to exemplify the principles covered in 84.344. 1 credit. Corequisite: 84.344.

86.361 Advanced Organic Chemistry I

Provides in-depth coverage of properties and reactions of organic compounds stressing such aspects as synthetic methods and reaction mechanisms. 3 credits. Prerequisites: 84.224, 84.345.

86.362 Advanced Organic Chemistry II

Serves as a continuation of advanced level study of organic compounds stressing synthesis and reaction mechanisms. 3 credits. Prerequisite: 86.361.

86.421 Special Topics in Chemistry

Offers an in-depth treatment of one or more areas of advanced chemistry or industrial applications of chemistry. Students enrolling in the course must have the permission of the chemistry coordinator. 3 credits.

86.471 Industrial Chemistry

Discusses essential chemical principles in selected areas of industrial concern, including the effect of industrial processes on the environment. 3 credits. Prerequisites: 84.224, 84.345.

86.481 Chemistry of High Polymers I

Discusses the physical and organic chemistry of monomers and polymers, including a consideration on non-bonding forces, spectroscopic methods of structure determination, fractionation and thermodynamics. 3 credits. Prerequisites: 84.224, 84.345.

86.482 Chemistry of High Polymers II

Serves as a continuation of 86.481. Topics presented will include methods of molecular weight determinations for polymers in solution; kinetics of condensation and addition polymerization; and mechanisms of free radical and ionic polymerization. 3 credits. Prerequisite: 86.481.

Civil Engineering

14.203 Statics

Discusses vector concepts of forces and moments of forces. Static equilibrium of particles, rigid bodies and simple structures. Static friction forces. Geometric properties of sections. 3 credits. Prerequisites: 92.132 or 92.126 and 95.144, 96.144. (Offered in summer only)

14.204 Strength of Materials

Introduces the concept of stress and strain at a point, stress-temperature relationships, force and deformation analyses of bodies under axial, shearing, flexural, torsional and combined loadings, shear and bending moment diagrams, and Euler Columns. 3 credits. Prerequisite: 14.203. (Offered in summer only)

14.350 Structural Analysis

Presents principles of structural analysis applied to typical civil engineering structures as the initial step in the total design concept. Basic emphasis on the classical methods of analysis of statically determinate and indeterminate structures. The personal computer as an analytical tool. 3 credits. Prerequisite: 14.204. (Offered in summer only)

Civil Engineering Technology

15.113 CAD

Demonstrates CAD concepts using both class discussion and laboratory work. Using interactive computer graphics workstations, students will create two civil/architectural drawings that involve the processes of inserting and modifying lines, arcs, text, dimensions and other geometric entities. AutoCAD® is used in this course. 2 credits. Prerequisite: 23.101 or permission of instructor.

15.123 Surveying I

Presents principles and methods of data collection and manipulation using both classroom discussion and actual hands-on field work. Theories and methods of instrument techniques for measurement of length, direction, rectangular coordinates, boundary areas, earthwork volumes and topographic data will be presented. An introduction to and use of state-of-the-art total station survey equipment is included. Students will manipulate electronically collected data using microcomputer-based coordinate geometry and CADD software in Field-to-Finish classroom exercise. Fieldwork projects utilizing a broad range of equipment give students facility in surveying techniques. One session per week and six Saturdays of fieldwork. 4 credits. Prerequisites: 92.115, 23.101.

15.124 Surveying II

Serves as a continuation of 15.123. Application of standard and innovative surveying techniques in classroom and fieldwork to engineering problems directly related to transportation route analysis, selection, design and construction. All aspects of horizontal and vertical alignment will be discussed, including curve design and earthwork computations using state-of-the-art microcomputer-based route surveying software and CADD. Fieldwork projects will be typical of the applications of route surveying to transportation engineering. One session per week and four Saturdays of fieldwork. 4 credits. Prerequisite: 15.123.

15.152 Water Biology

(formerly 20.152)

Serves as an introduction to the biology of natural waters. Topics include freshwater animals, plants, community relationships, population dynamics, effects of pollution and water borne disease. Includes some lab and field work. 3 credits.

15.224 Materials/Structural Laboratory

Provides an experimental study of construction materials such as steel, concrete, etc. and the properties of soil. Material will also include flexor test of beam and load test of truss. 1 credit. Prerequisites: 15.251, 15.253.

15.225 Water Chemistry I

(replaced by 86.131)

15.237 Statics

Discusses the fundamentals of statics, including such topics as force systems, resultants, equilibrium, friction, first moments of masses and areas. 3 credits. Prerequisites: 92.125, 99.131. Corequisite: 92.126

15.238 Dynamics

Presents the laws of kinematics of particles and rigid bodies involving absolute and relative motion. Newton's law as applied to the kinetics of rigid bodies in motion will be discussed. Principles of work and energy, impulse and momentum are also covered. 3 credits. Prerequisite: 15.237.

15.239 Strength of Materials

Discusses principles of strength of materials, centric, torsional and flexural loading, principle stresses, Mohr's stress cycle strain, temperature effects, shear and moment diagrams. 3 credits. Prerequisite: 15.237.

15.242 Steel Design I

Covers the selection and proportioning of structural steel members to resist axial, shearing, bending and combined stresses. The design of simple riveted, bolted and welded connections will be covered. Use of current AISC Specifications and Commentary is also presented. 3 credits. Prerequisite: 15.251.

15.246 Fluid Mechanics/Hydraulics

Presents the properties of fluids, principles of hydrostatic pressure, fluid flow with applications to orifices, tubes, weirs, and pipes. Two demonstration laboratory sessions will be held during the semester. 3 credits. Prerequisite: 15.237 or 23.221.

15.247 Hydraulics Laboratory

Presents the fundamentals of measurements in the general area of hydraulics. Laboratory topics include friction losses in pipes and valves, flow through venturi and orifice, hydraulic ram, study of open channel flow, etc. 1 credit. Prerequisite: 15.246.

15.251 Structural Analysis I

Presents methods of analysis of statically determinate structures. Topics covered include: reactions, shear and moment diagrams, analysis of trusses, truss types and stability, influence lines for beams and trusses, moving loads and approximate analysis of statically indeterminate structures. Solution of trusses and frames by a general purpose structural analysis computer program is also presented. 3 credits. Prerequisite: 15.239.

15.253 Reinforced Concrete I

Presents the selection and design of reinforced concrete members to resist axial, shearing, bending and combined stresses by the Working Stress Design method and the Strength method. Design of rectangular beams, T-beams, and slabs will also be discussed. Use of current ACI Specification and Commentary is also covered. 3 credits. Prerequisite: 15.239.

15.254 Soil Mechanics I

Provides an elementary treatment of the physical properties of soil, such as bearing and shearing strength, seepage, soil pressure, compressibility and settlement. Also covers the application of soil properties to soil classifications. 3 credits. Prerequisite: 15.239.

15.256 Water and Wastewater Lab

(replaced by 15.263)

15.257 Highway Elements

Provides an introduction to the broad field of highway design and engineering, including planning, vehicle/driver/traffic characteristics, soils, drainage, earthwork, pavement types, construction, operations and maintenance, etc. Included are discussions of the layout and design of various facilities; the effects of government policies on highways; and the possible social, economic, and environmental effects of highway facilities. 3 credits. Prerequisite: 15.124.

15.261 Wastewater Treatment Plant Operations I

(formerly 20.251)

Discusses State Rules and Regulations, preliminary treatment, primary treatment, secondary treatment, disinfection, sludge handling and disposal. The primary emphasis is on the activated sludge process. Operational control processes are discussed in detail and "hands-on" visits to local wastewater treatment facilities are included. 3 credits. Corequisite: 15.263.

15.262 Legal Aspects of Land Surveying

Covers topics such as property law, property transfer, boundary law, property descriptions and titles, survey plats, water law, liability and litigation, professional ethics and standards, and land information systems. Students will learn a proven method of how to gather and organize property line information at Registries of Deeds and Probate, and how to present this information in an efficient manner to the field crew and the person responsible for the final property line determination. Students will also learn about the use of other sources of property line information found at municipal offices, local museums and archives, and the Massachusetts Land Courts. Special responsibilities that land surveyors have in establishing property lines on land abutting tidelands, tidal rivers, streams and great ponds will also be covered. 3 credits. Prerequisite: 15.123 or permission of instructor.

15.263 Wastewater Treatment Lab I

Serves as an introductory course, teaching the basic laboratory techniques and procedures used to operate and monitor biological wastewater treatment facilities. Included are solids, dissolved oxygen, chlorine residual, pH, BOD, total coliform, alkalinity, acidity, sludge and microscope analysis. 1 credit. Corequisite: 15.261.

15.264 Fundamentals of Land Development

Presents the administrative/legal, environmental, economic and sociological factors influencing land development, planning methods and geographical information systems. Topics include: site planning and subdivision; administrative, permitting, design and development processes; legal aspects; land interests, rights of private ownership, land records systems; environmental considerations and growth issues; economic factors; and geographical information systems. 3 credits. Prerequisite: 15.123 or permission of instructor.

15.272 Water Supply & Treatment Operations I

(formerly 20.351)

Provides an introduction to the principles and practices of operation and maintenance relative to drinking water supplies and treatment plants. Using case studies, the following topics are covered; sources of supply, well and reservoir operation, contaminants and regulation, hazardous materials, overview of treatment, chemical feeding, coagulation, settling, operating conditions, filtration, solids handling, disinfection, chlorination and fluoridation. 3 credits.

15.274 Water Works Operations Lab I

(formerly 20.353)

Introduces the students to fundamental laboratory equipment as it applies to the operation of water treatment facilities. The following determinations will be conducted: odor, color, turbidity, jar tests, pH, chlorine residual, acidity, alkalinity, hardness, chlorines, iron, manganese, phosphate, aluminum, nitrogen, cycle, coliform, microscopic analysis, heavy metals, and organics. 1 credit.

15.280 Industrial Waste Treatment

(formerly 20.354)

Examines the state and federal regulations for industrial wastewater treatment. Basic chemistry is covered and physical chemical treatment for neutralization, oxidation-reduction, metals removal, and cyanide destruction. Filtration, ion exchange, and reverse osmosis are discussed. Chemical feed systems, sludge handling and dewatering are also presented. 3 credits.

15.299 Surveying III

Introduces and explores advanced surveying topics, building upon those covered in Surveying I & II. Demonstration labs in Field Astronomy and Error Theory will be included within the scheduled class time. Specific topics to be covered will include: Photogrammetry, including interpreting aerial photographs for ground measurements and mapping; Geodesy, Map Projection Systems and State Plane Coordinates; Field Astronomy, including Astronomic Positioning (determining true azimuths by solar and stellar observations); Control Surveys, including horizontal and vertical control networks as well as control surveys procedures and computations; Error Theory, including making calculations of and adjustments to precise survey networks as well as EDM Theory. 3 credits. Prerequisite: 15.124.

15.326 Water Chemistry II

(replaced by 86.132)

15.340 Hazardous Waste Management

(formerly 20.356)

Addresses the current topic of hazardous waste management in an interdisciplinary manner. Topics include hazardous waste regulations, regulatory agency functions, industrial hazardous waste management systems (contingency plans, closure plans, spill control plans, etc.), treatment, storage and disposal techniques (present and future), facility siting, source reduction techniques and right-to-know legislation. 3 credits.

15.352 Structural Analysis II

Serves as a continuation of 15.251. Deflection calculations for beams, trusses and frames are presented. Analysis of trusses, beams and frames by energy methods and moment distribution will also be covered. The solution of trusses and frames by a general purpose structural analysis computer program is addressed. 3 credits. Prerequisite: 15.251.

15.355 Water Distribution Systems

(formerly 20.255)

Introduces the principles, materials and practices relative to the operation and maintenance of drinking water distribution systems. The following topics will be covered: system hydraulics, pumping, mains, services, valves, hydrants, metering, flushing, storage, fire control, leak control, cross connection prevention, disinfection, etc. 3 credits.

15.356 Water Treatment

Provides the student with the basic principles of planning water supply development and designing water treatment unit operations and distribution systems. Principles of population projecting, estimating water demand, and water supply development and protection are included. Water treatment unit operation design including removal mechanisms and loading rates are identified. Basic hydraulic concepts as they relate to water distribution systems are also introduced. 3 credits.

15.358 Wastewater Treatment

Presents the basic principles of designing wastewater treatment and residuals processing unit operations, as well as concepts of effluent and residuals disposal and reuse. Physical, biological and chemical treatment options are introduced. Removal

mechanisms and loading rates for wastewater and residuals treatment on a unit operation-by-unit operation basis are identified. Entire treatment trains, as well as basic concepts of effluent and residuals disposal and/or reuse are discussed. 3 credits. Prerequisite: 15.356 or permission of instructor.

15.361 Wastewater Treatment Plant Operations II
(formerly 20.252)

Serves as a continuation of 15.261. The operation and maintenance of biological processes is emphasized. Phosphorous removal and nitrification are covered. Two stage activated sludge and batch reactors are discussed. An introduction to pumps, control systems and physical chemical treatment of industrial wastes is included. Two field trips to advanced wastewater treatment facilities are conducted on Saturdays. 3 credits. Prerequisite: 15.261. Corequisite: 15.363.

15.363 Wastewater Treatment Lab II
(formerly 20.254)

Serves as an advanced course designed to teach the lab techniques and procedures used to operate and monitor advanced wastewater treatment facilities. Includes "hands-on" analyses for ammonia, nitrates, phosphorous, jar test, COD, BOD, total coliform, fecal coliform, turbidity and heavy metals. 1 credit. Prerequisite: 15.263. Corequisite: 15.361.

15.372 Water Supply and Treatment Operations II
(formerly 20.352)

Serves as a continuation of 15.272, covering the following topics: corrosion control, oxidation, and aeration, use of ozone, chlorine dioxide and potassium permanganate, iron and manganese carbon, softening, instrumentation and control, system contamination and control, reverse osmosis, ultra-filtration, electrodialysis, distillation and UV, and energy management. 3 credits. Prerequisite: 15.272.

15.374 Water Works Operations Lab II
(formerly 20.355)

Serves as a continuation of 15.274, and includes the following topics: fluoride, fecal, coliform, phosphate, algae and microscopic analyses, filterability, TKN, TOC, heavy metals with AA apparatus, activated carbon assessment, and laboratory quality assurance. 1 credit. Prerequisite: 15.274.

15.378 Air Quality Management

Discusses air pollutants, their characterization, sources, emission rates, ambient concentration, effects on health, animals, vegetation, and aesthetics. Provides historical survey of air pollution and air resources management in the U.S. and worldwide, the Clean Air Acts and Amendments from 1963 to date, National Environmental Policy Act of 1969, National Ambient Air Quality Standards, Emission Standards, Prevention of Significant Deterioration, State Implementation Plans. Basics of pollutant dispersion, transport and transformation in the atmosphere, including dry and wet deposition are also covered, along with emission control technologies for particulate matter, carbon monoxide, sulfur oxides, nitrogen oxides, organic vapors, the automobile engine, and its emission and control technologies. Ambient and "in stack" monitoring methods will be presented. 3 credits. Prerequisite: 84.122 or permission of instructor.

15.383 Steel Design II

Serves as a continuation of 15.242. Design of beam-columns, moment-resisting connections, built-up plate girders, and composite beam and slab sections are covered. Consideration of basic structural members as elements within frame and floor systems are also discussed. 3 credits. Prerequisite: 15.242.

15.388 Pumps and Compressors
(formerly 20.388)

Covers the operation and maintenance of various types of pumps such as centrifugal, positive displacement, rotary, air lift and chemical feed. Pumping hydraulics, control systems, mechanical seals and packing will be discussed in detail. The operation and maintenance of compressors and blowers, their application and troubleshooting will be covered. 3 credits.

15.391 Reinforced Concrete II

Serves as a continuation of 15.253. The analysis of and design for the behavior of the basic concrete members on structural frames and floor systems is discussed. Using design curves and graphs as an aid to the solution of practical problems is also presented. 3 credits. Prerequisite: 15.253.

15.392 Soil Mechanics II

Serves as a continuation of 15.254 with emphasis on application of principles. Design of foundations such as caissons, spread footings and piles is presented. The design of retaining structures and the treatment of embankments is also covered. 3 credits. Prerequisite: 15.254.

15.394 Soil Mechanics Lab

Presents common soil laboratory tests including soil classifications, atterberg limits, strength and compressibility tests. 1 credit. Prerequisite: 15.254.

15.396 Groundwater Resources

Provides an introduction to the basic concepts of groundwater hydrology, starting with a discussion of the origin and occurrence of groundwater and progressing to the hydrologic cycle, aquifers, and basic geology as applied to groundwater hydrology. Essential concepts of groundwater hydrology will be covered, including Darcy's law, aquifer parameters, gradients and flow nets. The final third of the course will cover methods of determining aquifer hydrologic properties, including a review of field investigation methods, wells and aquifer test concepts and procedures. 3 credits.

15.420 Solid Waste Management

Examines science, engineering and management issues pertaining to the collection, treatment and disposal of municipal solid wastes. Municipal waste quantification, characterization and generation patterns are reviewed as an introduction to this course. Design and operation of waste collection systems is covered. Modern landfilling technologies which utilize landfill liners and capping systems are described. The issues of reuse and recycling of waste constituents and community composting for the disposal of biodegradable materials are presented as an alternative to landfilling. The mechanical, chemical and operational aspects of modern combustion processes such as engineered incineration systems are covered in detail. 3 credits.

15.452 Operation and Maintenance of Wastewater Collection Systems

(formerly 20.452)

Examines the proper operation and maintenance of wastewater collection systems. Inspection, testing, installation, and repairs of the collection system are covered. Health hazards encountered in this work are addressed and safety is emphasized. Pumping

station operation and maintenance are discussed in detail. Confined space entry and working hazardous environments are also addressed. 3 credits.

15.463 Construction Technology

Presents a descriptive and analytical study of methods and equipment used in the planning and execution of construction projects; as well as the critical path method of scheduling. 3 credits. Prerequisite: 15.257 or permission of instructor.

15.470 Project Management

Promotes the development of management skills and techniques needed to plan, schedule, supervise and control projects. Project estimating; labor cost and productivity, specifications and contracts; time, cost and quality control; and project decision-making and financing are covered. 3 credits. Prerequisite: 15.463.

15.486 Transportation Elements

Serves as a continuation of 15.257, presenting selected topics in the field of transportation such as traffic, integrated public transportation, planning and developmental impact of transportation routes. 3 credits. Prerequisite: 15.257.

15.492 Water/Wastewater Plant Management

(formerly 20.257)

Presents an introduction to the principles of management with emphasis on topics related to the operation of water and wastewater treatment plants. The following subjects are discussed: staffing, labor relations, public relations, financing, budgeting, legislation and management principles. 3 credits. Prerequisite: experience in water/wastewater treatment or permission of instructor.

15.495 Civil Engineering Technology Elective

Presents advanced topics from the subdisciplines of Civil Engineering Technology; that is, structures, transportation, sanitary technology or soil mechanics. Offered at student request and conditional on sufficient enrollment. 3 credits. Prerequisite: completion of the required courses in the subdiscipline in which the course is offered.

Clinical Laboratory Sciences

35.101 Human Anatomy & Physiology I

Provides an introduction to the study of the human organism relating structure and function. The topics treated are cytology, histology, the skeletal system, the muscular system, body plan, the nervous system, and the endocrine system. This course is designed to provide students with a working knowledge of human anatomy and physiology through an understanding of the fundamental principles involved in the structure and function of the body through interrelationships and through feedback mechanisms. Clinical applications will be presented. 3 credits. Corequisite: 35.103.

35.102 Human Anatomy & Physiology II

Serves as a continuation of the study of the human organism relating structure and function. The topics treated are the circulatory, respiratory, digestive, excretory, and reproductive systems. The course is designed to provide students with a working knowledge of human anatomy and physiology through an understanding of the fundamental principles involved in the structure and function of the body through interrelationships and through feedback mechanisms. Clinical applications will be presented. 3 credits. Prerequisites: 35.101, 35.103. Corequisite: 35.104.

35.103 Human Anatomy & Physiology Laboratory I

Reinforces didactic material by practical exposure to the subject matter. A second major outcome will be an understanding of laboratory methodology using a thoughtful approach to problems, precise procedures and an appreciation of variables. 1 credit. Corequisite: 35.101.

35.104 Human Anatomy & Physiology Laboratory II

Reinforces didactic material by practical exposure to the subject matter. A second major outcome will be an understanding of laboratory methodology using a thoughtful approach to problems, precise procedures and an appreciation of variables. 1 credit. Prerequisites: 35.101, 35.103. Corequisite: 35.102.

35.211 Basic Clinical Microbiology & Pathology

Studies the fundamentals of microbiology with major emphasis on structure, function, growth, metabolism, and classification of clinically important

microorganisms. The human body's response to invading microbes and an introduction to the ecological aspects of microorganisms in the environment with particular stress on their significance, activities (beneficial and detrimental) and control measures will also be studied. 3 credits. Prerequisites: 35.102, 35.104. Corequisite: 35.213.

35.213 Basic Clinical Microbiology & Pathology Laboratory

Laboratory investigations of basic properties and characteristics of microorganisms are conducted. Students will perform commonly used techniques for collecting, handling, and studying clinically important microorganisms. 1 credit. Prerequisites: 35.102, 35.104. Corequisite: 35.211.

35.356 Pharmacology

Introduces the chemistry, biochemistry, and physiological actions of various pharmaceuticals. Fundamental concepts will be stressed and will include a discussion of drug receptors, drug receptor interactions, pharmacokinetics, enzyme induction, drug metabolism, drug safety and effectiveness, and idiosyncratic reactions. Several major groups of drugs will be studied including: central nervous system stimulants, hypnotics, narcotic analgesics, anti-inflammatory drugs, cholinergics, adrenergics, adrenergic blocking drugs, antihypertensives, antihistamines, diuretics, adrenal steroids, anti-anemic drugs, and antibiotics. Articles from the current literature will be discussed. 3 credits. Prerequisite: 35.252 Physiological Chemistry†. (Offered in summer only)

Computer Mathematics

Students registering for programming courses may be required to spend non-class time at the University's Computer Center.

90.160 Introduction to Information Systems

Provides the non-Information Systems student with an understanding of how computer hardware and software are combined to build efficient and effective information systems for business professionals. The course takes a users orientation toward the use

† Offered through the day school. See UMass Lowell's Undergraduate Catalog for course description.

of the application tools, how to develop applications without programming, how users can build decision support systems, how to use the structured system development life cycle, how to control information systems and life cycle, and how personal computers can be interfaced with other systems. 3 credits.

90.170 Introduction to Paradox® and PAL Programming

Provides a framework to allow the student to comprehend the concepts of Paradox and database management in general. Course will be divided between interactive Paradox and PAL Programming. 3 credits.

90.172 Application Software: Windows™

Provides hands-on experience in Windows development. Topics covered will include creating and displaying text in a window, controls (buttons, list boxes, edit controls, etc.), dialog boxes, menus and string resources, memory management, DLLs, MDIs, and DDE. Knowledge of C++ is helpful but not essential. Emphasis will be placed on the ability to use an existing class library (MFC) to significantly speed up Windows projects. 3 credits.

90.240 Computer Applications and Purchasing

Helps students gain the knowledge and skills needed to contribute significantly to the computerization of a company's purchasing operations. Topics will include: the managerial role of purchasing; structuring your computer's purchasing system; using open purchase orders; receiving and accounts payable; making the move to paperless purchasing; system requirements, software package feasibility; preparing a detailed, item-by-item vendor data base segment and what it should contain; keeping outside groups from contaminating vendor files while still meeting their needs; preparing bid requests and purchase orders for Electronics Data Interchange (EDI); and integrating point of receipt terminals and bar coding into computer systems to record receipt of ordered items. 3 credits.

90.268 Strategic Planning for Information Systems

Provides a methodology for strategic MIS long-range planning that encourages managers and planners to examine and consider all facets of MIS operations. It will teach the student how to think "integration."

The student will be given the details and mechanics for developing a comprehensive MIS long-range plan. The orientation is "what" to include and/or consider and then how to approach a solution to a given problem and provide helpful support justification for selling the plan and ideas. This course would be helpful in varying degrees to anyone directly or indirectly associated with the MIS long-range planning process, such as: MIS long-range planners, Directors of information services, Managers in MIS operational areas, user managers, corporate planners, corporate officers, and members of the MIS steering committee. 3 credits.

90.370 Application Software Production Lifecycles

Examines the key elements involved in introducing a new computer application product and marketing's role in the management of the product lifecycle. The important elements of product introduction are presented. These include market analysis, business plan, sales strategy guide, merchandising program (announcement plan, product briefs, advertising, etc.) and follow-up support considerations. The importance of marketing's interface to the product development organization is also examined. A case study illustrating these key concepts is included. 3 credits. Prerequisites: two high-level programming languages and 42.224 or 42.226.

90.420 Introduction to Artificial Intelligence/Expert Systems

Presents history of AI, current Expert Systems applications (MYCIN, DENDRAL, XCON), predicate calculus, search, knowledge representation and natural language. Exposure to LISP and PROLOG. 3 credits. Prerequisites: 92.267, or 92.360.

90.457 Computer Ethics & Security

Offers an introduction to computer information security. Topics include justification of the need for security and definition of the common threats and vulnerabilities through government legislation and security requirements, risk analysis, security awareness programs, physical and system security, data encryption, understanding viruses and other types of malicious codes, and communications security. The course ends with a project involving performing a security audit and producing a computer security policy. 3 credits. Prerequisite: Junior status.

90.458 Advanced Topics in Computer Security

An opportunity for students to study a selected topic of computer security in depth. The topic will be announced each semester and will be one of the following subjects: database security, network security, operating system security, cryptography and risk analysis, performing a security audit, and producing a computer security policy. Class may be repeated for credit when topics vary. 3 credits.

90.476 Introduction to Novell® NetWare

Includes the following Novell certified courses: 105 Introduction to Networking; 200 Networking Technologies; and 701 NetWare: Service and Support. This course provides an overview of basic networking concepts, a data communications framework, and connectivity. Networking literacy is raised by an introduction to the industry language and the popular industry protocols. Provides prerequisite information including NetWare TCP/IP Transport, NetWare for SAA: Installation & Troubleshooting, NetWare Dial-in/Dial-out Connectivity, NetWare Communication Services, and LANtern Services Manager. Finally, there is a focus on installation and upgrade procedures for the latest versions of Novell NetWare, maintenance including network board configurations, network cabling, disk expansion, and troubleshooting of NetWare networks and common problems. 3 credits.

92.202 Microcomputers and Applications Software

Provides an introduction to the processing of information by microcomputers. Topics include computer logic, memory and input/output. Use of applications software including 1) spreadsheets, 2) word processors, 3) graphics and, 4) databases will also be covered. 3 credits.

92.211 Introduction to Programming with C

Offers an introduction to the processing of information by computer. Computer logic, memory, input/output processing, and programming in the "C" language. Students may not receive credit for both 92.211 and 92.267. 3 credits. Prerequisite: 92.121 or equivalent.

92.219 BASIC® Programming

Presents programming in BASIC, including nested loops, subscripted variables, string manipulation, subroutines and advanced programming techniques. 3 credits. Prerequisite: 90.111 or working knowledge of another programming language.

92.263 FORTRAN Programming

Examines the programming principles of FORTRAN including input-output, arithmetic and control statements, arrays, functions and subroutines. Structured programming will be emphasized. Students will process several problems. 3 credits. Prerequisite: 90.112 or 92.121 or equivalent.

92.265 Pascal Programming

Serves as an introduction to computer programming using the Pascal language. Topics to be discussed include the elements of algorithm design and data structures; algorithm development by step-wise refinement; language control structures, functions and procedures; the standard data types; scalar data types; and an introduction to structured types. Students will process a number of programs on the University computer. 3 credits. Prerequisite: 90.112 or 92.121 or equivalent. Area III.

92.267 C Programming

Introduces students to the techniques of programming in C. The language syntax, semantics, its applications and the portable library are covered. 3 credits. Students may not receive credit for both 92.211 and 92.267. Prerequisite: 92.265.

92.268 C++ Programming

Provides an introduction to the programming principles of C++ including pointers, file I/O, operator overloading and classes. These concepts will be applied to simple data structures such as lists and trees. Object oriented programming techniques will also be emphasized. 3 credits. Prerequisite: 92.267.

92.269 Advanced C++

Serves as a continuation of 92.268, with emphasis on Object Oriented Programming with C++. Design issues and programming guidelines will be discussed. Inheritance, dynamic binding, overloaded operators, abstract classes, and class hierarchies will be covered in more detail, with course projects concentrating on these areas. 3 credits. Prerequisites: 92.268, experience with data structures.

92.311 Introduction to the UNIX® Operating System

Addresses manipulating and maintaining files within the UNIX file system; creating and editing text files using the vi and ed editors; using pipes, redirection, and filters; using advanced text processing utilities; using electronic mail; writing and debugging shell scripts; submitting and executing processes. 3 credits. Prerequisites: 92.267 or 92.211 and 92.364.

92.312 UNIX Shell Programming

Teaches the concepts, features, and functions of the Bourne Shell. The course covers the building blocks necessary to programming the shell. Shell scripts are developed which can be used as new utilities. 3 credits. Prerequisite: 92.311.

92.313 UNIX Internals Overview

Focuses on the fundamentals of UNIX kernel architectures. Topics covered in this course are: the file system, process creation, signals, process scheduling, context switching, memory management, virtual memory device driver basics and the I/O subsystem, system boot, the init process. 3 credits. Prerequisite: 92.312.

92.314 UNIX System Interface Programming

Introduces a UNIX programmer to the tools which are necessary to take advantage of all the facilities provided by the UNIX operating system. Use of system calls as well as the pros and cons of using direct system calls on the C library routines will be discussed. 3 credits. Prerequisites: 92.311 and 92.455.

92.316 UNIX System Administration

Addresses the fundamentals necessary to set up/adjust a UNIX system to produce an efficient and secure operating system environment. System starting and shutdown, file system partitioning and maintenance, user and group administration, backup and recovery, setting up terminals, printers and communications devices are topics which will be discussed. 3 credits. Prerequisite: 92.312.

92.317 Developing Portable Applications

Addresses programmers who are required to port code or move programs between various platforms and environments. 3 credits. Prerequisite: 92.311.

92.360 Introduction to Data Structures

Presents the basic concepts of data, linear lists, strings, arrays, and orthogonal lists, using C. Trees and graphs, storage allocation and collections, multilined structures, symbol tables, as well as searching and sorting (ordering) techniques will also be covered. 3 credits. Prerequisites: 92.267 or 92.211 and 92.364.

92.363 SPSS-X (Introduction to Data Analysis)

Explores the computer analysis of data derived from research in the social, behavioral and life sciences. Topics include data presentation, organization and coding; developing SPSS-X input deck with various control and procedure cards; generating SPSS-X files; data modification, recoding and transformation of data; file manipulation, producing input/output files, deleting, retaining, adding variables, etc.; and statistical procedures, from descriptive to multi-variate statistics. Data sets, including completed questionnaires, will be issued to students for practice in working with the SPSS-X system and performing various functions. 3 credits. Prerequisite: Basic Statistics.

92.364 Problem Solving with C

Intended as a practical problem-solving course, to give students further exposure to the topics covered in 92.267 and to provide the tools needed for software development. The course emphasizes these aspects of the programming problem-solving process: problem specification and organization; algorithms, coding, debugging; the elements of good programming style; and the means of producing a high-quality finished product. Programming examples are chosen to span a wide range of both numeric and non-numeric applications. 3 credits. Prerequisite: 92.211 or 92.267.

92.365 COBOL Programming I

Presents the programming principles of COBOL, the Common Business Oriented Language. Identification, environment, data and procedures divisions, introduction to compilation procedures and diagnostic processing will be covered. Programming of basic applications, such as inventory and accounting problems is also discussed. 3 credits. Prerequisite: 92.219.

92.366 Problem Solving with FORTRAN

Discusses advanced FORTRAN programming techniques including multi-dimensional arrays, all FORTRAN data types, character data, file manipulations, advanced subprogram argument passing and multi-dimensional array addressing. Additional topics include testing and debugging, numerical operating system and implementation of algorithms. 3 credits. Prerequisite: 92.263.

92.368 COBOL Programming II

Serves as a continuation of 92.365. Advanced programming problems in COBOL, discussion of COBOL systems software, sophisticated routines and generalized business file manipulation will all be presented. 3 credits. Prerequisite: 92.365.

92.388 Principles of Software Quality Assurance

Provides the student with a basic understanding of the elements of an effective Software Quality Assurance (SQA) program. Successful completion of the coursework will enable the student to contribute to the development and management of an SQA organization. Topics include general quality control, software applications, standards and program organization, personnel requirements, configuration management and controls, integrating SQA and MIS effectively, and statistical principles and techniques. 3 credits. Prerequisites: 92.183 and a minimum of two computer programming courses.

92.419 Computer Algebra with Mathematica®

Mathematica is an extremely powerful computer-based tool for solving problems. Computer algebra systems like *Mathematica* are used by engineers, scientists and mathematicians to assist them in attacking problems that require complicated and involved symbolic or numeric computations. 3 credits. Prerequisites: 92.126 and a computer programming language.

92.455 Assembly Language Programming I

Presents absolute machine language coding and the symbolic programming language. The coding of practice problems on a high-speed digital computer using the basic computer instructions including arithmetic, input-out, logic, control operations and data manipulation will be covered. 3 credits. Prerequisite: 92.263 or 92.265 or 92.267.

92.457 ADA

Introduces the syntax and semantics of the programming language ADA, including data structures and types, control structures, tasks, packages and generics. Practical exercises involving the language will be included. 3 credits. Prerequisite: 92.265 or 92.267.

92.461 Systems Simulation and Modeling

Presents procedures in model construction and computerized simulation, modeling tools and techniques, model conceptualization and implementation, and selected applications of simulation. 3 credits. Prerequisites: 92.263 or 92.265 or 92.267, 92.183.

92.462 Systems Programming

Addresses basic concepts of assembly programs and compilers, macro-generators, utility programs, supervisions, monitors, and high-level languages. 3 credits. Prerequisite: 92.360.

92.463 Systems Design and Development I

Presents a general study of the design and development of computer-oriented data processing systems including: the approach requirements of the system, developing the solution, data controls, system controls, system evaluation, and reporting to management. 3 credits.

92.464 Systems Design and Development II

Serves as a continuation of 92.463. Topics include: finalizing and implementing the system, post-installation evaluation, interdepartmental coordination, and case studies. 3 credits. Prerequisite: 92.463.

92.467 Assembly Language Programming II

Serves as a continuation of 92.455. Symbolic programming using advanced techniques including macro instructions, indirect addressing, file generation and processing, magnetic tape and magnetic disc applications are presented. 3 credits. Prerequisite: 92.455.

92.468 Microcomputer Principles and Applications

Discusses current microcomputer practices for both hardware and software including basic microcomputer instruction sets, operating systems, assembler and I/O programming, utilities, interrupts and interfaces. Scientific, industrial and business applications are studied. 3 credits. Prerequisite: 92.265.

92.469 Compiler Construction Techniques

Studies typical compiler organization including symbol tables, various types of scans, object code generation, error diagnostics and optimization techniques. Segments of a classroom compiler are written by students. 3 credits. Prerequisite: 92.462.

92.470 Data/Telecommunications

Examines data transmission, media, data encoding, digital data communication techniques, data link control, modems, PC communications software, multiplexing, communication networking techniques, and an introduction to local area networks. 3 credits. Prerequisites: 92.267, 92.360.

92.472 Local Area Networks

Discusses local area network technology, protocols for local area networks, digital PBX concepts, internetworking concepts and protocols, and network management. Emphasis on emerging standard protocols, standard protocols and widely used proprietary protocols. 3 credits. Prerequisite: 92.470.

92.473 Computer Network Architecture and Protocol

Presents the various network architectures, protocols, and how they fit within the OSI seven layer model. This course covers the leading edge technologies such as distributed computing and services which will help in the evaluation and/or implementation of networked systems. 3 credits. Prerequisite: 92.472.

92.474 Data Base Concepts

Introduces data base directives, design elements of 3 data bases, architectures, and commercial data bases. Students will participate in design of a large-scale data base application and administration of this data base. Students will also program the basic concepts on a machine. 3 credits. Prerequisites: 2 semesters of higher level language, excluding BASIC.

92.475 Communication Network Management

Presents network management concepts, issues and standards. Discussions will cover various vendor network configurations, maintenance and planning. Emerging trends and technologies will also be covered. 3 credits. Prerequisite: 92.472.

92.476 Computer Organization

Presents the computer architecture knowledge the software engineer needs. Students are introduced to the representation of information and the concepts of gates and elementary logic. Storage mechanisms and memory organizations are described and a functional layout of an elementary computer is given. Addressing methods are explained and various methods of I/O are discussed. Microprocessors, large computers, parallelism, and distributed logic are also covered. 3 credits. Prerequisites: 92.265, 92.455.

92.477 Information Systems I

Serves as an introduction to Management Information Systems (MIS), emphasizing information needs at various management levels, including problem finding as well as problem solving. The course highlights the use of real time, distributed data processing, decision support and expert systems in the decision-making process of today's business. The student will understand how the use of different hardware and software can answer a wide range of "what if" questions, crucial in today's planning function. 3 credits. Prerequisite: Junior status.

92.478 Information Systems II

Serves as a continuation of 92.477, stressing the systems approach of MIS, focusing on methodologies used and the control over MIS as it relates to other business areas. Case studies are used to unify preceding topics as they relate to corporate planning, marketing, manufacturing, accounting, finance and personnel subsystems. 3 credits. Prerequisite: 92.477.

Computer Science

91.101 Computing I

Offers an introduction to the VMS operating system; the Pascal language; linear data structures and their representation, arrays, records, and linked lists. Abstract data types, stacks, and queues. Simple sorting via exchange, selection, and insertion. Recursion. Programming style, documentation, and testing. Ethical and social aspects of computing will be explored as special topics. 4 credits.

91.102 Computing II

Discusses ordered lists and rings, binary and AVL trees, advanced sorting via quicksort, heapsort, etc, sets, hashing, characters, strings, and graphs. Also gives an introduction to files, programming style, documentation, and testing. Ethical and social aspects of computing will be explored as special topics. 4 credits. Prerequisite: 91.101.

91.203 Computer Organization and Assembly Language

Presents the organization and operation of a conventional computer, including principal instruction types, data representation, addressing modes, program control, I/O, assembly language programming, including instruction mnemonics, symbolic addresses, assembler directives, system calls, and macros, the usage of text editors, symbolic debuggers, and loaders, and the use of pseudocode in guiding structured assembly language programming. 4 credits. Prerequisite: 91.101.

91.204 Systems Programming

Introduces issues in the functionality, design, and implementation of translation software focusing on assemblers, linkers, and loaders. Topics include the objective of program translation, one- and two-pass assemblers, program modules, external resolution, program relocation, attribute binding, and lexical and syntactic analysis. 3 credits. Prerequisites: 91.102, 91.203.

91.301 Organization of Programming Languages

Provides an in-depth study of LISP and several other programming languages such as ALGOL, MODULA-2, FORTRAN, PL/I, APL, ADA, C, SNOBOL, PROLOG, and FORTH. Reviews basic data types. Constructs for specifying and manipulating data types. Language features affecting static

and dynamic data storage management. Also covers language constructs for specifying program control and data transfer, procedures, functions, block structures, interrupts, decision tables, recursion, string processing and vector processing features, run-time considerations and their relationship with various language features, compilation vs. interpretation, and syntactic and elementary semantic descriptions. 3 credits. Prerequisite: 91.204.

91.303 Analysis of Algorithms

Presents a development of more sophisticated ideas in data type and structure, with an introduction to the connection between data structures and the algorithms they support. Covers data abstraction, controlled access structures, trees, lists, graphs, arrays, and elementary consideration of algorithm design strategy: backtracking, greedy strategy, divide and conquer, branch and bound. Topics also include elementary techniques for analysis: recursion equations, estimation methods, elementary combinatorial arguments. Provides an examination of problem areas such as searching, sorting, shortest path, matrix and polynomial operations, and the indicated representations and algorithms. The student will be expected to use the techniques learned in this course and in previous courses to solve a number of logically complex programming problems. 3 credits. Prerequisites: 91.201 Computing III†, 92.322.

91.305 Computer Architecture

Examines the basic functional components of a computer system including the CPU, memory systems, and I/O systems. Each of these three areas will be developed in detail with a focus on the system design and component integration. Topics will include CPU control and ALU operation, computer timing, data address and I/O bus activity, addressing model, programmed and DMA I/O, and instruction sets and microcode. 3 credits. Prerequisites: 91.203, 16.267 Logic & Design†, 91.102.

91.308 Introduction to Operating Systems

Presents an introduction to major operating systems and their components. Topics include processes, concurrency and synchronization, deadlock, processor allocation, memory management, I/O devices and file management, and distributed processing. Techniques in operating system design, implemen-

† Offered through the day school. See UMass Lowell's Undergraduate Catalog for course description.

tation, and evaluation will be examined. 3 credits.
Prerequisite: 91.305.

91.420 Artificial Intelligence

Discusses LISP, tree and graph searching algorithms: breadth first, depth first, and uniform cost. Also covers heuristic search methods, admissibility, and games: mini-max, alphaBeta. Students will learn theorem proving and question-answering. 3 credits.
Prerequisite: permission of instructor.

Criminal Justice and Paralegal Option

44.101 The Criminal Justice System

Presents a brief history of the criminal justice system and an analysis of its structure and function. Required for all Criminal Justice majors and prerequisite to all courses in Criminal Justice. 3 credits.

44.111 Introduction to Industrial Security

Serves as an introduction to the planning, organization and management of industrial, business and government security resources, including the systems approach to security operations. This course focuses on the protection of assets via the integration of physical, personnel and information security. Relations between security organizations and government agencies are also explored. 3 credits.

44.141 Police Functions

Examines the historical development of police work with special emphasis on the conflicting role expectations facing the police officer. 3 credits.

44.151 Introduction to Corrections

Provides a comprehensive view of the theory, practice and philosophy involved in the treatment of convicted law violators of all ages. 3 credits.

44.201 Computer Applications in Criminal Justice

Provides the student with an introduction to the use and application of computers and computer programs in word processing, data processing and spreadsheet applications as they pertain to the field of criminal justice. By the end of the course, students will be able to utilize all three applications. This is a laboratory course. 3 credits.

44.211 Physical Security

Addresses the basic principles of physical security, with emphasis on tailoring these principles to the protection of specific operations and facilities. In addition, students will learn the significance of proper planning, design, modern techniques and devices that enhance security while reducing costs. 3 credits.

44.221 Criminology I

Presents the definition and nature of crime, criminal statistics and a survey of theories of crime causation. 3 credits. Required for all Criminal Justice majors.

44.233 Criminal Procedure

Explores the workings of the legal system as they pertain to the criminal justice professional. Particular emphasis will be placed on the proper legal procedures leading up to and including court proceedings. 3 credits.

44.234 Criminal Law

Discusses the historical origins and development of criminal law from early common law to contemporary decisions and statutes. Constitutional and statutory factors as they pertain to crime, defense, and crimes against persons and property will be considered. In addition, attention is directed toward limitations of criminal responsibility, capacity and the law of arrest. Sections of the Massachusetts Criminal Code and other statutes will be covered where applicable. 3 credits.

44.241 Principles of Investigation

Gives the student a solid understanding of the organization, techniques and procedures in carrying out a proper investigation. Some of the examples will include such topics as arson, larceny, sexual offenses, forgery and fraud. Other important aspects will include establishment of investigative priorities, fiscal restraints and informational management. 3 credits.

44.243 Criminalistics I

Presents basic procedures in arrest, search and seizure, and the gathering as well as the evaluation of evidence as to admissibility, weight and competence. 3 credits. Prerequisite: 2 semesters of science.

44.244 Criminalistics II

Discusses collections, identification, preservation and transportation of physical evidence. The crime laboratory and its effectiveness capabilities and limitations in assisting the police officer and utilizing physical evidence as a means of apprehension and/or conviction will also be addressed. 3 credits. Prerequisite: 44.243.

44.251 Institutional Corrections

Focuses on the assessment of the U.S. prison system and jail system, highlighting such priorities as 1) changing offender priorities, 2) institutional crowding, 3) violence in prison, 4) the privatization of prisons, 5) the rediscovery of treatment, and 6) furlough policy. 3 credits.

44.261 Juvenile Delinquency

Analyzes causative factors in the development of youthful offenders. The development and philosophy behind treatment of juvenile court and clinic, training schools and contemporary innovative practices will be covered. 3 credits.

44.287 Legal Writing for Paralegals

Reviews and strengthens good writing techniques necessary for all legal writing with an emphasis on organization, grammar, clarity, and legal style. Building on this foundation, the student will then prepare writing assignments which include litigation documents, transactional documents, legal correspondence, and legal memoranda. Elements of informative and persuasive writing techniques are stressed. Each student receives individual attention to help develop skills and confidence and prepare outstanding writing samples for his or her portfolio. 3 credits.

44.301 Computer Applications for the Legal Profession

Introduces students to legal applications utilizing PC's. Emphasis is on hands-on instruction in a variety of legal software packages including word processing, spreadsheets, and database management. 3 credits.

44.312 Security Management

Addresses the basic interdisciplinary principles of security management including planning, budgeting, organizing, staffing, directing and controlling. This course will also cover marketing security services to management, risk management, civil and

criminal liability, and labor relations. Each aspect of the course is designed to prepare security managers to face the new challenges as broader and more cost-effective protection is required with fewer resources. The course will also bring about greater awareness and understanding of the various options available in security and loss control. It will identify a number of risk areas and outline various deterrent and preventative methods. 3 credits.

44.321 Criminology II

Examines the theories of criminal behavior, both historical and contemporary, and their impact on the evolution of punishment, treatment and rehabilitative practices. 3 credits. Prerequisite: 44.221.

44.331 Penal Law

Studies the constitutional rights of incarcerated individuals, including major policy issues and trends associated with recent revisions of penal codes reflecting court decisions for the preservation of offenders' rights. 3 credits.

44.335 Juvenile Court: Philosophy and Practice

Examines the civil procedures used in the juvenile court as opposed to the adversary procedures used in criminal court, together with a history of the development of the juvenile court and an examination of its constitutional basis. 3 credits. Prerequisite: 44.261.

44.341 Comparative Police Systems

Studies various police systems on the national and international level and makes a comparison with local systems on the basis of organization, structure, and administration of law enforcement agencies. Agencies in Europe, the United Kingdom, the Soviet Union and the United States will be reviewed. 3 credits.

44.342 The British Criminal Justice System

Presents a study of the British Criminal Justice System, and is offered alternating summers in conjunction with the faculty of Oxford University. The program includes travel and intensive lectures and on site study of the various aspects of the British Criminal Justice System. Lectures by Oxford University faculty will be coordinated with the on-site inspections. Oxford University's library resources will be available to the student to help in the preparation of a required research paper. 6 credits.

44.351 Community Based Corrections

Provides a comprehensive review of the use of community-based sanctions and community-based early-release mechanisms. In addition to traditional probation and parole topics, such topics as an assessment of "new" intermediate sanctions, electronic monitoring, intensive supervision, boot camps, day fines, day reporting centers, and community service sentences. 3 credits.

44.354 Probation and Parole

Presents the historical development of both probation and parole, and provides an examination of their place in the criminal justice system. There will be an emphasis on recent trends including diversion, flat sentencing, week-end sentencing and the problems resulting from departure from traditional practices. 3 credits.

44.360 Gender, Race and Crime

Examines the gender and racial implications of criminal laws, criminal justice practices and programs. The impact of historical and present day institutional practices will be analyzed on the basis of gender and race. The position of women and racial/ethnic minorities will be presented from the different perspectives of victims, offenders and criminal justice practitioners. 3 credits. Prerequisite: 44.234.

44.370 Criminal Justice Management

Introduces the principles of administration, including planning, budgeting, grantsmanship and evaluation as they relate to the criminal justice system. 3 credits.

44.371 Criminal Justice Planning and Evaluation

Serves as a continuation of 44.370, placing particular emphasis on student design and evaluation of programs and plans. 3 credits. Prerequisite: 44.370 or equivalent.

44.372 Issues in Correctional Administration

Conducts specific analysis of the management of correctional institutions, including custody, classification, reception, programming, release, staffing, scheduling, collective bargaining and other related issues. 3 credits. Prerequisite: 44.370 or equivalent.

44.373 Issues in Police Administration

Presents specific analysis of the management of the contemporary police force, including staffing, scheduling, training, collective bargaining, community relations and other related issues. 3 credits. Prerequisite: 44.370 or equivalent.

44.380 Selected Issues in Criminal Justice

Discusses current issues and problems in criminal justice. Subjects taken up in the course will vary but will include such questions as victimology, social and psychological aspects of crime, crime control and deterrence, evaluation and policy research. 3 credits.

44.385 Crime and Mental Illness

Considers the realities and myths surrounding the relation between mental illness and crime. An analysis of case studies and of material from criminal justice and psychology will be a major component of this course. 3 credits.

44.390 Introduction to Criminal Justice Research

Introduces research methods for the criminal justice professional. Topics include terminology, standard methodologies and elementary statistics. 3 credits.

44.401 Drugs and the Criminal Justice System

Addresses the problems of drugs, drug abuse, the law and its application. Treatment of and alternatives to drug rehabilitation will be studied in addition to the classification, identification, distribution and control of drugs. 3 credits.

44.410 Women in Criminal Justice

Identifies and seeks to understand assumptions in theories and in practice as they relate to women as criminals, victims and criminal justice practitioners. Biological, psychological and sociological theories will be analyzed, and the implications of such theories will be discussed. Women's reactions to both the theories and practices will be examined. 3 credits.

44.422 Victimology

Examines the patterns of victimization, the characteristics and lifestyles of crime victims, and the impact of their victimization. The treatment of victims by the Criminal Justice System will be examined along with possible reforms in these approaches. 3 credits.

44.423 Elite Deviance and Crime

Examines the systematic violation of the laws and ethics of business and politics. The structure of power and privilege in relation to both political and economic deviance will be major topics. The impact of corporate crime and deviance on society and the societal and legal reactions will be explored. 3 credits. Prerequisite: 44.221.

44.435 Alternative Dispute Resolution

Provides students with an in-depth understanding of complementary forms of dispute resolution such as mediation, negotiation, and arbitration. Students will learn about the widespread applications of alternative dispute resolution—from divorce mediation, to labor arbitration, to large environmental disputes. Training in negotiation, mediation, and interpersonal skills is stressed through role playing. 3 credits.

44.490 Criminal Justice Research Seminar

Provides specific practice in the definition, design and execution of a research project. Presents an analysis of the impact of contemporary criminal justice research on policy development. 3 credits. Prerequisite: 44.390.

44.496 Practicum

Assigned fieldwork under the supervision and with the permission of the coordinator. This course is designed to broaden the educational experience of pre-service students in law enforcement and corrections by providing exposure in selected correctional, law enforcement, probation and parole agencies within the area. This course is intended to provide a correlation of theoretical knowledge with practical experience in an area of particular interest to the students. 3 credits.

44.497 The Paralegal Practicum/Internship

Assigned fieldwork under the supervision and with the permission of the coordinator. This course is designed to broaden the educational experience of paralegal students by providing exposure to selected legal environments such as corporate legal departments, financial institutions, law firms, real estate departments, banks, and government agencies. This course is intended to provide a correlation of theoretical knowledge with practical experience in an area of particular interest to students. 3 credits. Prerequisite: minimum of 3 paralegal courses.

Economics

49.201 Economics I (Microeconomics)

A study of the principles of production and exchange. An introduction to demand, supply, pricing, and output under alternative market structures. Derived demand and resource markets are introduced. 3 credits. Area I.

49.202 Economics II (Macroeconomics)

A study of the principles governing the level of national income and employment. Also examines the commercial banking system, monetary and fiscal policy, the international economy, and alternative economic systems. 3 credits. Area I.

49.211 Statistics for Business and Economics I

Presents descriptive statistics, sophisticated counting techniques and other components of probability, simple random variables and their distribution, bivariate functions, sampling theory properties of estimators. 3 credits. Prerequisite: 90.111 or 92.121.

49.212 Statistics for Business and Economics II

Discusses interval estimation, hypothesis testing, analysis of variance, applied regression theory, correlation analysis, and other selected topics. 3 credits. Prerequisite: 49.211.

49.302 Labor Economics

Explores the effect of American capitalism on the position of labor. The rise of union organization and the factors in its growth. Trends in the labor force, money and real wages, wage problems and wage differentials, problems of hours and working conditions, and causes and remedies for unemployment. 3 credits. Prerequisites: 49.201, 49.202.

49.303 Microeconomic Theory

Provides an advanced examination of price and production theory and the theory of the consumer and the firm. 3 credits. Prerequisites: 49.201, 49.202.

49.307 Government & Business

Examines various governmental and nongovernmental controls on business and nonprofit organizations. Emphasis is placed on the impact of laws, court interpretations, economic theories, social and political philosophies, and ethical consideration on these organizations. Students will have an opportunity to

examine business decisions which involve questions of value and choice. 3 credits. Prerequisites: 49.201, 49.202. Area I and Human Values (for College of Management majors only).

49.312 Managerial Economics

Applies the economic theory and statistical methods to business decision making. Estimation of demand, production, cost functions and accompanying elasticity estimates, pricing and output decisions, value maximization problems, and capital budgeting. 3 credits. Prerequisites: 49.201, 49.202, 49.211, 49.212.

49.315 Introduction to Environmental Economics

Examines environmental problems caused by externalities and market failure. An analysis of pollution controls such as voluntary programs, direct controls, taxes on emissions, and other monetary incentives is evaluated. Environmental problems in planned economies are also discussed. 3 credits. Prerequisite: 49.201.

49.318 Financial Markets and Monetary Policy

Discusses the economics of financial intermediation and central bank monetary policy. Evaluation of global financial markets, financial deregulation, bank failures and financial stability, determinants of the level and term structure of interest rates, and the impacts of monetary policy changes on overall levels of output, employment and prices will be topics analyzed in this course. 3 credits. Prerequisites: 49.201, 49.202.

49.403 International Trade Theory

Presents the classical and modern theories. International payments, exchange and trade controls, and international trade policy determinants. 3 credits. Prerequisites: 49.201, 49.202. Area I.

49.407 Econometrics

Reviews the basic assumptions, estimation with deficient data, multiple regression, formulation and estimations of special models, the generalized linear regression model and its applications, and simultaneous equation system. 3 credits. Prerequisites: 49.201, 49.202, 49.211, 49.212 or permission of instructor.

Electrical Engineering

16.202 Circuit Theory II

Discusses the sinusoidal forcing function, complex numbers, phasors, sinusoidal steady-state conditions, impedance, average real power, reactive power and rms values, exponential forcing function, poles and zeros in the s-plane, concept of the system function and its use in determining the forced response and resonance, reactance cancellation and concept of s-plane vectors. The course also covers Thevenin's and Norton's theorems, superposition, reciprocity, and maximum power in the frequency domain, impedance and admittance and hybrid parameters for a two-port network, introduction to matrices and their use in circuit analysis, general response by pre-box techniques, magnetic coupling, mutual inductance, and ideal transformer. Engineering Science (100%). 4 credits. Prerequisite: 16.201†. Corequisite: 16.208. (Offered in summer only)

16.208 Basic EE II Laboratory

Presents experimental work designed to emphasize electrical measurement techniques of linear systems with time-varying signals. Waveform measurements with dc and ac meters as well as advanced use of the oscilloscope are also discussed. Experiments are integrated with course 16.202. Experiments cover: Kirchhoff's laws for phasors, magnitude and phase measurements of impedance, network theorems, frequency response, resonance, inductance, transformers, and maximum power transfer. Engineering Science (50%); Engineering Design (50%). 2 credits. Prerequisite: 16.207†. Corequisite: 16.202. (Offered in summer only)

16.211 Fundamentals of Electricity I

Serves as an introduction to direct current and alternating current analysis of electric circuits, with emphasis on energy and power. Covers design and use of multirange voltmeters, ammeters, and ohmmeters, the use of bridges and oscilloscopes, phasor analysis of AC circuits, Trigonometric Fourier series, BODE plots, transformers, relays, solenoids, mechanical analogs and magnetic analogs with the application of Fourier and BODE techniques. Students will also be introduced to DC and AC motors and generators, residential circuits, equipment protection, and introduction to digital logic including

† Offered through the day school. See UMass Lowell's Undergraduate Catalog for course description.

minimization techniques. Availability and cost of instruments and components is stressed throughout this course. Not for EE majors. Engineering Science (100%). 3 credits. Prerequisites: 92.132, 92.134†. (Offered in summer only)

16.409/410 Project Laboratory

Provides an opportunity for qualified Electrical Engineering students to investigate specific areas of interest. The actual project undertaken may be software or hardware oriented. The most important characteristics of the projects are that the end results represent independent study and that they are research and development oriented, and that they are accomplished in an engineering environment. Design reviews and progress reports are expected for each project. A final formal report to be permanently filed in the EE Department is required for each project. Engineering Design (100%). 3 credits. Prerequisites: At least three courses from 16.355†, .360†, .362†, .365†, and .366†. (Offered in summer only)

16.461 Electromagnetic Theory II

Serves as a continuation of Electromagnetic Theory I with emphasis on time varying fields. Faraday's law, induced EMF's, displacement current, Maxwell's equations including the constitutive relationships, propagation of plane waves in both dielectric and conducting media, reflection of plane waves from boundaries between different media, Poynting's theorem, skin depth, transmission line theory reflection coefficients and standing wave analysis, stub matching and the use of Smith charts for admittance and impedance calculations. Engineering Science (100%). 3 credits. Prerequisites: 16.202, 16.360†, and 16.315†. (Offered in summer only)

Electronic Engineering Technology

17.130 Electrical Basics and Laboratory

Introduces the basic principles of electrical engineering, including the concepts of voltage, current, resistance, inductance and capacitance. Ohm's Law, Kirchhoff's Laws, Thevenin's theorem and Norton's theorem will be covered. Alternating current concepts, frequency response and filters are discussed. The use of laboratory power supplies and measur-

ing instruments such as oscilloscopes, voltmeters, ammeters and ohmmeters are demonstrated. Computer terminals are available in the laboratory and their use is expected. Written reports are required. Alternate lecture and laboratory sessions. Not available for EET majors. 2 credits. Prerequisites: 42.226, 99.132, and either 92.219, 92.263, or 92.267.

17.131 Electronic Basics and Laboratory

Serves as a continuation and elaboration of 17.130. Topics include: diodes; transistors and electronic amplifiers; power supplies; and feedback and control systems. Magnetics and electromechanics, AC power systems and rotating machines are also covered. Computer terminals are available in the laboratory and their use is expected. Written reports are required. Alternate lecture and laboratory sessions. Not available for EET majors. 2 credits. Prerequisite: 17.130.

17.132 Digital Basics and Laboratory

Presents an introduction to number systems and digital logic, including both combinational and sequential digital logic networks. Other topics include: binary, decimal, octal, and hexadecimal number systems; base conversion; Boolean algebra; Karnaugh maps; and sequential counters. Computer terminals are available in the laboratory and their use is expected. Written reports are required. Alternate lecture and laboratory sessions. Not available for EET majors. 2 credits. Prerequisite: 17.130.

17.133 Electro-Optics: An Overview

Presents an introduction and overview of principles and practices of electro-optical technologies and their applications. Topics include: signals and fields, their generation, manipulation, detection, processing and control, "field" technologies (patterning, picture generation and holography, storage technologies, etc.), electro-optical tools and processing (optical scanners, tweezers, etc.), optical (field) measurement techniques (e.g. holographic interferometry), fiber optic superhighways, high definition TV, 3D optical storage, laser disk storage technologies, smart fiber optic sensing networks, gigabit solution communication lines, and remote optical sensing. Advances in components such as lasers, detectors, storage devices, EO display as well as new electro-optical applications in communications, biotechnology and medicine, security, environmental monitoring, computer and information retrieval will be introduced. 3 credits.

† Offered through the day school. See UMass Lowell's Undergraduate Catalog for course description.

17.213 Electric Circuits

Discusses electrical units; voltage, current and resistance; energy, power and charge; Ohm's Law, Kirchhoff's Current Law and Kirchhoff's Voltage Law; simplification and conversion techniques for networks containing sources and/or resistance; Thevenin's and Norton's theorems; fundamentals of magnetism and magnetic circuits; and meters and measuring. 3 credits. Prerequisites: 92.125 (May be taken concurrently), and either 92.219 or 92.267.

17.214 Circuits and Laboratory I

Provides a continuation of 17.213. Topics include sinusoidal waveforms, phasors, impedance, network elements, rheostats and potentiometers. Mesh and nodal analysis of AC circuits; series and parallel circuits, series-parallel circuits, superposition and Wye/Delta conversions are also covered. The use of power supplies and measuring instruments such as oscilloscopes, voltmeters, ammeters and ohmmeters will be studied. Computer terminals are available in the laboratory and their use is expected. Written reports are required. Alternate lecture and laboratory sessions. 2 credits. Prerequisites: 17.213, 42.226, 92.126 (May be taken concurrently).

17.215 Circuits and Laboratory II

Serves as a continuation of 17.214. Topics to be discussed include maximum power transfer, real and reactive power; resonance; and polyphase systems. Oscilloscopes, voltage, current and phase measurements are demonstrated. Other topics include series and parallel sinusoidal circuits, series-parallel sinusoidal circuits, series resonance, parallel resonance and transformers. Filters, 2-port networks, computer aided circuit analysis (SPICE). Computer terminals will be available in the laboratory and their use is expected. Written reports are required. Alternate lecture and laboratory sessions. 2 credits. Prerequisite: 17.214.

17.216 Advanced Circuits

Provides an extension and elaboration of the principles covered in 17.213, 17.214 and 17.215. Circuits and systems undergoing transient conditions caused by a variety of excitations, both natural and forced, will be explored using the Laplace-Transform method. Application to mechanical, fluidic, thermal circuits and filters are presented as an introduction to electromechanical, electronic and control systems. 3 credits. Prerequisites: 17.215.

17.230 Mathematics & Statistics/E.E.T.

(replaces 17.382)

Uses the computer to apply mathematics, probability and statistics, to technological problems. Topics include probability, statistics, regression, correlation, goodness of fit, variance, probability distributions and the computer solution of algebraic equations associated with multivariable statistical problems. 3 credits. Prerequisites: 17.350, and either 92.265 or 92.267.

17.317 Minicomputer Programming

(replaced by 17.384)

17.346 Logic Design A

(replaces 17.371)

Studies the number systems, switching algebra and combinational logic. Topics include: number systems and binary codes; switching algebra and algebraic simplification; minimization of switching functions using Karnaugh maps, variable-entered maps, and tabular method; multi-level networks; multiple-output networks; network conversion and mixed logic; designs using decoders, multiplexers, read-only memories, programmable logic arrays, and programmable array logics. 3 credits. Prerequisite: 17.355.

17.347 Logic Design B

(replaces 17.372)

Serves to extend the principles of 17.346 or 17.371 to sequential networks. Topics include: synchronous sequential networks; state diagrams and tables; transition tables; state assignment; merger graphs and tables; implication graphs; fundamental mode asynchronous sequential networks; and flow tables, cycles, races, and critical race free assignments. 3 credits. Prerequisite: 17.346 or 17.371.

17.348 Logic Design C & Laboratory

(replaces 17.367)

Provides a laboratory-oriented course. Theories learned in 17.346 and 17.347 are applied to the design and building of digital circuits with TTL integrated circuits on a portable logic design kit. Written reports are required. Laboratories include realization of switching functions using decoders and multiplexers, designs of multiple-output circuits, code-correcting circuits, synchronous sequential circuits using flip-flops and binary counter, and an arithmetic processor. 2 credits. Prerequisites: 17.353 and either 17.347 or 17.372.

17.350 Control Systems I

Serves as a basic course in feedback control theory, which applies Laplace transform and frequency response. Approximation techniques are developed to achieve an optimum design of a practical multi-loop servo having velocity feedback and integral-network compensation. The general time behavior of a control system is studied, including the use of error coefficients to compute the angular error of a radar tracking antenna. 3 credits. Prerequisite: 17.216.

17.353 Digital Electronics

Presents the building blocks and concepts associated with digital electronic networks. Combinational networks, Eber-Moll Transistor model, state devices, logic families (RTL, TTL, ECL, CMOS), read-only memories (ROM's), static and dynamic MOS random access memories (RAM's), programmable logic array (PLA's) and macro cell logic are discussed. 3 credits. Prerequisites: 17.356 and 17.346 or 17.371.

17.355 Electronics & Laboratory I

Provides an introduction to electronic signals and systems. Amplifier characteristics and two-port networks will be presented. Diode characteristics and applications, rectifiers, power supplies, filters, comparators and limiters are also discussed. Computer terminals are available in the laboratory and their use is expected. Written reports are required. Alternate lecture and laboratory sessions. 2 credits. Prerequisite: 17.215 (May be taken concurrently).

17.356 Electronics & Laboratory II

Serves as a continuation of 17.355. Waveform generators, junction field-effect transistors (JFET's), graphical analysis, small signal equivalent networks, biasing and multistage amplifiers are covered. Computer terminals are available in the laboratory and their use is expected. Written reports are required. Alternate lecture and laboratory sessions. 2 credits. Prerequisite: 17.355.

17.357 Electronics & Laboratory III

Serves as a continuation of 17.356, and discusses the following topics: metal-oxide-semiconductor field-effect transistors (MOSFET's), bipolar junction transistors (BJT's), as well as single and multi-stage amplifiers. Computer terminals are available in the laboratory and their use is expected. Written reports are required. Alternate lecture and laboratory sessions. 2 credits. Prerequisite: 17.356.

17.358 Electronics & Laboratory IV

Serves as a continuation of 17.357. Topics to be covered include: single and multi-stage amplifiers, frequency response, feedback, analog integrated circuits, filters and oscillator circuits. Computer terminals are available in the laboratory and their use is expected. Written reports are required. Alternate lecture and laboratory sessions. 2 credits. Prerequisite: 17.357.

17.361 Project Laboratory A

Outlines and discusses possible projects with students submitting detailed proposals. The most feasible projects are then assigned to teams of students for implementation. Use of the computer as a tool to solve experimental problems is encouraged. Written reports are required. Credit by examination will not be granted for this subject. 2 credits. Prerequisites: 17.353, 17.358 and 17.365.

17.365 Applied Linear Devices

Discusses the linear and non-linear applications and characteristics of linear integrated devices. Optimal use of industry published specifications, application notes and handbook data will be stressed. Topics to be covered include operational amplifiers, regulators, comparators, analog switches, time function generators, instrument circuits, logarithmic circuits, computing circuits and signal processing circuits. 3 credits. Prerequisites: 17.350 and 17.357.

17.367 Digital Devices and Laboratory

(replaced by 17.348)

17.368 Data Conversion and Laboratory

Serves as a continuation of 17.348 or 17.367, covering the fundamentals of data conversion devices including R/2R ladder networks, weighted resistor and weighted source networks, analog-to-digital and digital-to-analog converters, voltage-to-frequency and frequency-to-voltage converters and sample and hold networks. Approximately one-half the course time will be an associated laboratory. 2 credits. Prerequisite: 17.348 or 17.367.

17.371 Logic Design I

(replaced by 17.346)

17.372 Logic Design II

(replaced by 17.347)

17.376 Electromagnetic Theory I

Reviews vector analysis electrostatic theory and applications including electric field, potential, Gauss' Law, divergence, stored energy, boundary conditions, forces, dielectric materials, conductivity, electrostatic mapping, capacitance, as well as Poisson's and Laplace's equations. Magnetostatic theory, including the magnetic field, Lorentz force, motion of charged particles in combined electric and magnetic fields, Amperes Law, inductance, stored energy, boundary conditions, magnetic materials, and magnetics are also covered. Applications including two-wire transmission line, electrostatic shielding, electron emission, magnetic shielding and magnetic circuit design will also be presented. 3 credits. Prerequisites: 17.358, 92.226, and 99.133.

17.380 Microprocessor Basics

(replaced by 17.383)

17.382 Problems - EE Technology

(replaced by 17.230)

17.383 Microprocessors A

(replaces 17.380)

Introduces the microprocessor and microprocessor programming through an integrated set of experiments and related lectures. Topics include binary, decimal, and hexadecimal numbers, the microprocessor, memory devices, structure of microprocessor-based systems, programming and instruction sets, addressing modes, arithmetic, logical, and shift instructions, branch conditions and instructions, indexed addressing, the stack, subroutines, assembly language, floating point routines, and software development techniques. Approximately one-half of the course time will be an associated laboratory. The course will culminate with a programming project. 2 credits. Prerequisite: 17.346 or 17.371.

17.384 Microprocessors B

(replaces 17.317)

Extends the programming skills developed in 17.383 to interfacing the microprocessor to the outside world through an integrated set of experiments and related lectures. Topics include architecture of microprocessor-based systems, microcontrollers, parallel I/O ports, interrupts, A/D and D/A converters, programmable timers, handshaking and serial communications. Approximately one-half of the course time will be an associated laboratory. The course will culminate with an interfacing project. 2 credits. Prerequisite: 17.380 or 17.383.

17.391 Project Laboratory B

Requires students to submit project proposals compatible with the advanced technical electives offered. Teams are then assigned to implement selected projects. Use of the computer as a tool to solve experimental problems is encouraged. Written laboratory reports are required. Credit by examination will not be granted for this subject. 2 credits. Prerequisites: 17.361, 17.348 or 17.367, 17.230 or 17.382 and at least one 17.4—Electronic Engineering Technology elective.

17.392 Project Laboratory C

Requires students to submit project proposals compatible with the advanced technical electives offered. Teams are then assigned to implement selected projects. Use of the computer as a tool to solve experimental problems is encouraged. Written laboratory reports are required. Credit by examination will not be granted for this subject. 2 credits. Prerequisites: 17.361, 17.348 or 17.367, 17.230 or 17.382 and at least one 17.4—Electronic Engineering Technology elective.

17.427 Digital Signal Processing

Presents the fundamentals of discrete-time signals and systems analysis. Fourier analysis of analog signals and systems is reviewed. Z-transforms, discrete Fourier Transforms (DFT's), and Fast Fourier Transform (FFT) algorithms are discussed. The properties and analysis of both Infinite Impulse Response (IIR) and Finite Impulse Response (FIR) filters are considered. Issues related to implementation of digital filters in software, special digital hardware, and DSP chips are discussed. Computer solution of filtering problems is an integral part of the course. 3 credits. Prerequisites: 17.353, 92.234, and either 92.265 or 92.267.

17.431 Electromagnetic Compatibility

Provides a working knowledge of electromagnetic interference (EMI) and compatibility (EMC), while illustrating actual interference situations and their solutions. This course will cover the characteristics of conducted and radiated interference and electromagnetic pulse (EMP) effects. Interference coupling mechanisms will be considered. Solutions to interference problems based on grounding, shielding and filtering techniques will be discussed. Emphasis will be placed on practical design procedures. Design issues regarding inter-system interference will be addressed. The course will also cover industrial and government standards, as well as EMC measurement and test procedures. 3 credits. Prerequisite: 17.376.

17.443 Photovoltaics

Offers a senior level electronic engineering technology course, giving an overview of photovoltaics, including the photovoltaic effect, topics in solid state electronics related to photovoltaic energy conversion, photovoltaic cell materials and manufacture, electrical storage, balance of system components for a complete system, system design, utility interconnection, and barriers to implementation. 3 credits. Prerequisites: 17.214 and 92.126.

17.447 Fiber Optics in Telecommunications

Introduces optical fiber technology for information transmission and telecommunications. The physical principles of optics and fiber types provide a general understanding of key physical parameters of the optical materials and structure. Optical fibers are analyzed as wave guidelines transmitting electromagnetic energy, including transmission characteristics and normal modes. The fiber optic transmission link is described, including optical sources and detectors, transmitter and receiver circuits, methods of data modulation and multiplexing, with several telecommunications applications. 3 credits. Prerequisite: 17.479.

17.449 Logic Design D

(replaces 17.473)

Serves as a continuation of 17.347 or 17.372. Pulse mode asynchronous networks, iterative networks, the structure of sequential networks, sets, relations and lattices, state assignment using partitions, serial and parallel decomposition, decomposition with specified components, state identification and fault detection experiments, linear sequential networks and applications of digital logic are all addressed in this course. 3 credits. Prerequisite: 17.347 or 17.372.

17.459 Power Converter Design I

Discusses the design of modern switching and linear power supplies, basic voltage regulators and power converters, square-wave power converters and regulators. Compound regulating systems, thermal considerations, series-pass regulators, DC/DC converter design, switching regulators and converters are also covered. 3 credits. Prerequisite: 17.365.

17.460 Power Converter Design II

Serves as a power converter design course dealing with the more popular types of modern high fre-

quency switching converters at the 150 to 500 watt level. This course is a continuation of 17.459, with emphasis on network analysis using Laplace Transforms and some BASIC programming. The analysis will be used to determine component stresses. Techniques for determining the stability of switching and linear regulators will also be presented. 3 credits. Prerequisite: 17.459.

17.461 Lasers and Laser Systems

Discusses the elementary quantum concepts of spontaneous and simulated photon emission. Optical resonator design including stability, resonant modes, and losses are considered. The theory of lasers is presented, including threshold inversion, oscillation frequency, operating inversion, power levels, output coupling, and mode locking. The operation and performance characteristics of the common gas, liquid, solid, molecular, chemical ion, and free electron lasers is presented, followed by the operating principles and characteristics of semiconductor lasers. Applications of lasers from the ultraviolet through far infrared are stressed. 3 credits. Prerequisite: 17.479.

17.462 Image Signal Processing

Provides an introduction to image signal processing and its mathematical fundamentals. Sensors, data formation, storage and access are considered. Data processing is divided into two and three dimensions. Two dimensional topics include image processing, region processing, and object recognition. Three dimensional topics include contours, lines, shading, and colors. Stereo, motion, and surface representation are also considered. Image files with halftoning are provided for class assignments. 3 credits. Prerequisite: 17.479.

17.463 Biomedical Electro-Optics

Provides background information on lasers, electro-optic modulators and optical fibers. It covers high energy lasers (primarily solid state), tunable and pulsed systems, and interaction of laser radiation with tissue and laser tweezers. Material explores high power optical fibers for beam delivery, imaging fiber bundles, fiber sensors (physical, chemical, biochemical), and integrated laser-fiber systems (laser catheters and endoscopes). Clinical applications covered include laser angioplasty, photochemotherapy, laser lithotripsy and ophthalmology. 3 credits. Prerequisite: 17.479.

17.464 Industrial Electro-Optics

Emphasizes current and advanced optical tools for manufacturing and automation. A brief review of related electro-optic principles is first given. This is followed by a systematic presentation of optical and machine-vision methods currently used in manufacturing. Topics covered include 2D and 3D inspection methods, factory-data communications, motion control, materials processing, and spectrographic techniques. Consideration is then given to factory automation. Industrial optical sensing, machine vision systems, intelligent videometric robots and telemanipulators are considered. 3 credits. Prerequisite: 17.479.

17.465 Digital Telecommunications

Presents digital telecommunications systems, including sampling and quantization, asynchronous and synchronous multiplexing, digital modulation, signal design, timing and synchronization, and system impairments. Transmission media are covered, with an emphasis on optical fiber transmission methods. Circuit and packet switching are described, including high-speed packet switching. Transmission standards such as Frame Relay, SONET (Synchronous Optical Network) and ATM (Asynchronous Transfer Mode) are discussed. 3 credits. Prerequisite: 17.346.

17.469 Control Systems II

Serves as an extension of 17.350. A practical and complex multi-loop servo is studied in detail. The servo has feedback of current, velocity and position, along with integral compensation, and includes the dynamics of mechanical resonance in the gear train. The error due to static friction is analyzed. Sampled-data theory is presented and applied to develop a method of dynamic computer simulation which can be implemented in the BASIC computer language. The servo system previously analyzed is simulated with this technique. 3 credits. Prerequisite: 17.350.

17.473 Logic Design III

(replaced by 17.449)

17.477 Electromagnetic Theory II

Reviews Maxwell's equations. The wave equation for free space propagation is discussed. The concepts of a time varying electromagnetic field, sinusoidal plane waves, planewaves in dielectric and conductive media, Poynting's vector, depth and penetration, force and radiation pressure, reflection of EM waves from perfect conductors, dielectrics, and multiple dielectrics will all be covered. Quarter wave and half-wave matching, polarization Brewster's angle and surface waves are also discussed. Introductory concepts in guided electromagnetic waves including transmission lines, waveguides and antennas from the viewpoint of Maxwell's equations will be explored. 3 credits. Prerequisites: 17.376 and 92.234.

17.478 Applied Electromagnetics

Presents the conventional two-conductor transmission line theory with emphasis on those results which can be applied to the analysis and design of waveguide transmission. A discussion of the most frequently used microwave oscillators, the magnetron and klystron, is presented. The traveling wave tube concept is also emphasized. The interaction of microwave radiation with magnetic materials and practical devices of importance will be studied. Special problems encountered when microwave techniques and methods are extended to the millimeter-wavelength limit of the microwave domain will be reviewed. 3 credits. Prerequisite: 17.477.

17.479 Electro-Optics

(replaces 17.479 Optoelectronics)

Provides a theoretical and practical introduction to optical and electronic devices used for the emission, control, propagation and detection of optical radiation. The physics of optical radiation using ray theory and Gaussian beam theory is first considered. This is followed by a detailed presentation of optical resonators, atomic interaction, the properties of lasers and the operating characteristics of the principal types of conventional and semiconductor lasers. Modulation and detection of information on optical signals is then discussed including imaging. The theory of optical conductors is then presented followed by a detailed discussion of fiber optic cable manufacture, installation, and carrier systems including SONET. Demonstrations are given to provide the student with practical hands-on experience. 3 credits. Prerequisites: 17.356, 99.133.

17.483 Microprocessor Hardware

Provides an introduction to the design of a 16 bit microprocessor system. The hardware requirements of interfacing the 8086 microprocessor to memory devices, EPROMs, dynamic RAMs and static RAMs as well as I/O devices are covered. The interface to the various microprocessor peripherals such as the Coprocessor, Bus Arbiter, DMA Controller, Programmable Interrupt Controller, and Dynamic Ram Controller is investigated. The 8086 system is compared to the 68000 system. 3 credits. Prerequisites: 17.348 or 17.367, and either 17.380, 17.383 or 17.384.

17.484 Microprocessor Software

Presents a study of the architecture and instruction set of the 8086 microprocessor. Subject areas include: addressing modes, data movement instructions, flag operations, arithmetic and logical instructions, bit manipulation instructions, primitive string operations, program control instructions, hardware control instructions, interrupt structures and procedures. Programming in the DOS environment and the ROM Bios will be covered. Students will be required to develop programs that exhibit their knowledge of both the instruction sets and good programming practices. The interpretation of written programs will also be investigated. 3 credits. Prerequisites: 17.348 or 17.367, and either 17.380, 17.383 or 17.384.

17.485 Communication Theory I

Offers an introduction to information, transmission and communication systems. Review of Fourier series and Fourier integrals, discussion of amplitude and frequency modulation systems will be a part of this class. An introduction to noise in electrical systems is also presented. 3 credits. Prerequisite: 17.376.

17.486 Communication Theory II

Serves as a continuation of 17.485. Pulse amplitude modulation (PAM), pulse code modulation (PCM) and pulse position modulation (PPM) systems will be discussed and analyzed. Detection theory, matched filtering signal design and receiver performance are also presented. Concepts of spread spectrum systems are also introduced. 3 credits. Prerequisite: 17.485.

17.487 Analog Filter Design

Presents a review of network analysis. This course also provides an introduction to synthesis, driving point impedance, approximation theory and transfer function realization. 3 credits. Prerequisite: 17.350.

17.490 Advanced Microprocessors

Studies the design of a 32-bit microprocessor system using the Intel 80386 and Motorola 68020, and the hardware requirements of interfacing the 32 bit data buses to memory devices. The interface to the various microprocessor peripherals such as the Intel 80387 and the MC68881 Coprocessors as well as the MC68851 Paged Memory Management Unit is investigated. System architecture including multitasking, virtual address translation, paging and protection schemes are also covered. 3 credits. Prerequisite: 17.483.

17.495 Microprocessor Control

Provides an introduction to computer peripheral controllers that interface to mass storage devices and communication networks. The hardware requirements of interfacing to hard disk, tape, cassette and floppy are studied. Other topics considered are the various communication protocols and the interface to local communication networks such as Ethernet and Starlan. Also considered are global communications using ASYNC, BISYNC, and SDL/HDLC. The necessary requirements to interface an 80188 microprocessor to each controller will be defined. 3 credits. Prerequisites: 17.348 or 17.367, and either 17.380, 17.383 or 17.384.

17.496 Radar Systems

Offers an introduction to radar system analysis. An overview of basic radar operation is followed by a discussion of the factors influencing the radar operations of target detection and parameter estimation. Transmitters, antennas, receivers and system losses will be discussed. Propagation effects and clutter interference will be presented. Signal processing techniques will be described. Synthetic aperture radar and pulse compression techniques will also be discussed. Time permitting, various applications will be described. 3 credits. Prerequisite: 17.376.

English

42.101 College Writing I

Examines the writing process and reviews fundamentals of grammar, sentence structure, and paragraph development. Students analyze rhetorical models by professional writers and are introduced to library research and techniques of documentation. Seven expository essays are required. 3 credits.

42.102 College Writing II

Reinforces the principles of good writing established in College Writing I. Students submit six essays based on critical analysis of readings in fiction, drama, and poetry. One documented research paper is required. 3 credits. Prerequisite: 42.101.

42.103 College Writing I for International Students

Serves as the equivalent to 42.101, for students who speak English as a second language. Credit for both 42.101 and 42.103 may not be granted. 3 credits. English composition requirement.

42.104 College Writing II for International Students

Serves as the equivalent to 42.102, for students who speak English as a second language. Credit for both 42.102 and 42.104 may not be granted. 3 credits. Prerequisite: 42.103. English composition requirement.

Note: Before enrolling in any English course numbered 42.201 or higher, students must complete 42.101, 42.102 (or their equivalent 42.103 and 42.104) to fulfill the University requirement of 6 hours in composition.

42.201 Great Books of Antiquity

Studies representative literary selections from the Bible, classical Greece and imperial Rome as embodiments of ancient views of life and reality. 3 credits. Area II.

42.202 Great Books of the Modern Period

Studies representative literary selections from the period of the Enlightenment to the present as embodiments of modern views of life and reality. 3 credits. Area II.

42.210 Drama

Presents a study of plays from the classical period to the present. 3 credits. Area II.

42.211 Poetry

Studies selections from the Renaissance through contemporary periods. 3 credits. Area II.

42.212 The Short Story

Offers a study of the development of the genre. 3 credits. Area II.

42.214 Satire

Focuses on selections from the classical through the contemporary periods, including satire in the media. 3 credits.

42.215 The Modern Essay

Provides a study of the essay as the literature of ideas, and presents a concentration of twentieth century writers with attention to early examples of the genre. 3 credits.

42.216 The Short Novel

Discusses nineteenth and twentieth century short novels as a literary genre. 3 credits.

42.217 The Horror Story

Explores the genre from Poe to the present. 3 credits. Area II.

42.218 Comedy

Presents the theory and practice of comedy from the Greeks to the present. 3 credits. Area II.

42.220 Creative Writing: Personal and Reflective Writing

Provides an emphasis on the writing process as students prepare autobiographical projects. Class time will focus on selected professional autobiographies and memoirs, as well as student writing. 3 credits.

42.221 Shakespeare and Performance

Decodes Shakespearean language for practical acting and character interpretation. Viewing of Royal Shakespearean Company Actors in performance of monologues and scenes. 3 credits.

42.222 Oral Communication

Develops and applies the basic speaking skills that can be adapted to a variety of personal and professional contexts. Emphasis is placed on selection, analysis, organization and presentation of speech materials. Practice skills include listening, interviewing and the delivery and critique of extemporaneous speeches. 3 credits.

42.224 Business Writing

Studies the theory and practice of writing letters, memoranda and reports on specific business and technical problems. Registration preference for students enrolled in Business programs. 3 credits. (May not also take 42.226.)

42.225 Basic Technical Writing

Explains writing effective letters, memoranda and reports on specific scientific and technical subjects while considering issues of audience analysis, editing and the use of graphics. 3 credits.

42.226 Technical and Scientific Communication

Studies the theory and practice of letters, memoranda, reports and oral presentations on specific scientific and technical problems. 3 credits. (May not also take 42.224.)

42.227 Essay Writing for English Majors

Analyzes and discusses the techniques and styles of selected professional essayists as well as the preparation of student essays. Emphasis will be placed on the writing process from prewriting through drafting and revising. English majors and minors only. 3 credits.

42.229 Essay Writing for Non-English Majors

Analyzes and discusses the techniques and styles of selected professional essayists as well as the preparation of student essays. Emphasis will be placed on the writing process from prewriting through drafting and revising. Non-English majors only. 3 credits.

42.230 Film Classics

Studies the elements of film as revealed in selected film classics with emphasis on critical analysis and evaluation. 3 credits.

42.231 The Documentary Film

Discusses the history and theory of nonfiction film as a way of recording and interpreting human events and natural phenomena. Through class discussions and numerous screenings of documentaries the filmmaker's purpose and techniques will be examined. 3 credits.

42.232 Film in Post WW II America

Presents an analysis of the formal, thematic, and cultural issues in the development of modern

American film. Focus will be on the melodramatic, musical, horror, and social problem films such as *The Best Years of Our Lives*, *Jailhouse Rock*, *Psycho*, *Chinatown*, and others. 3 credits.

42.241 Women in Film

Surveys the image of women in commercial film from its beginnings to the present, with emphasis on the films of the 1930's and 40's and the 1970's and 80's. Several commercial viewings will be scheduled. 3 credits.

42.242 The Heroine in Modern Fiction

Provides a study of selected short stories and novels which deal sympathetically with the changing roles of women. 3 credits.

42.250 The Bible as Literature

Presents a literary and historical analysis of selected Old and New Testament books. 3 credits.

42.260 Stage Design

Serves as an introduction to the technical expertise that goes into creating the world of a play. Learn theatrical design of set, costumes, lighting, and sound. Projects are scaled to student's experience. 3 credits.

42.261 Acting

Examines the theory and practice of acting including exercises in the elements and methods of acting and the preparation of a public performance. 3 credits.

42.262 Advanced Acting

Designed for acting students who have experience in amateur productions or may be considering careers in the field. Class work will involve rigorous training with theater professionals and will include text analysis, performance techniques, and the actor's role in the production process. Limited Enrollment. 3 credits. Prerequisite: 42.261, or equivalent, or permission of instructor.

42.264 Directing

Serves as an introduction to the process of directing a play. The evolution of the director's role in production and the techniques of play analysis, actor rehearsal and production design will be emphasized. Students will have the opportunity to direct in a scene study laboratory. Limited Enrollment. 3 credits.

42.265 Advanced Directing

Serves as a master class in the discovery of style for the experienced student. This course provides a practical application of the fundamental techniques of stage direction to scenes and short plays. 3 credits.

42.266 Drama After World War II

Surveys the development of drama in the post-war era with particular emphasis on the modern playwright's repudiation of conventional realistic dramaturgy. 3 credits.

42.267 Introduction to Shakespeare

Studies selected histories, comedies and tragedies. 3 credits. Area II.

42.291 History of English Literature I

Studies the historical development of English literature from its beginnings to Milton. Selected works by representative authors from each period are studied. 3 credits. Area II.

42.292 History of English Literature II

Studies the historical development of English literature from Dryden to the beginning of the twentieth century. 3 credits. Area II.

42.294 History of American Literature I

Studies the historical development of American literature from the Colonial period to the Civil War. Selected works by representative authors from each period are studied. 3 credits. Area II.

42.295 History of American Literature II

Studies the historical development of American literature from the Civil War to World War I. 3 credits. Area II.

42.300 Journalism

Addresses the basics of news, feature, and editorial writing; preparing for interviews and news conferences; as well as writing and reporting on speeches. It also covers the essentials of photo selection, editing and captioning. 3 credits.

42.302 Creative Writing: Fiction

Emphasizes practical approaches to fiction writing with students' work as the focus of class discussion. Students will gain an understanding of the choices available in order to express convincingly the understanding and truth every writer seeks to communicate. 3 credits.

42.303 Creative Writing: Poetry

Discusses the theory and practice of poetry. Conducted as a workshop with close analysis of student work. 3 credits.

42.304 Creative Writing: Playwriting

Studies the theory and practice of playwriting. The course begins with exercises (monologue, scene work) to develop the basics of dialogue and character, and moves toward structural issues as students complete a dramatic piece. 3 credits.

42.305 Reviewing the Arts

Provides instruction in writing short, critical essays in a journalistic mode on the performing or visual arts. Special emphasis is given to theater, movie and television criticism. 3 credits.

42.306 Professional Writing

Introduces the student to writing for business, government and the professions. Topics include copywriting and editing, resumes, memoranda, letters, instructions, reports and proposals. 3 credits.

42.307 History and Development of the English Language

Examines the phonetic, lexical, syntactical, and semantic shifts in the English language from its beginnings to the present. 3 credits. Area II.

42.317 British Literature of the Twentieth Century

Studies British short stories, novels, poetry, and drama. 3 credits. Area II.

42.330 The Twentieth Century British Novel

Presents a study of the novel from Conrad through Greene. 3 credits.

42.356 Literature of the Victorian Period

Discusses British fiction, poetry, and prose from 1830 to 1900. 3 credits. Area II.

42.362 Modern Drama

A study of selected Continental, British and American plays of the late nineteenth century to the present. 3 credits.

42.365 Fiction II

This workshop allows students to present their work for encouraging and constructive criticism. The focus is on the development of the writer's ability to see what needs revision. 3 credits.

42.366 Poetry II

Combines discussion and critique of student poems with readings in contemporary poetry and poetics. The focus is on enabling students to develop their individual voices, forms, and subjects. 3 credits. Prerequisite: 42.102, its equivalent or permission of instructor.

42.367 Playwriting II

Students must have some command of playwriting building blocks (character, dialogue and action). This course will guide the student through the writing of a full-length or a substantial one-act play. Classes will include a weekly laboratory with student actors who will stage scenes in the process of development. Students should come to the first class prepared to discuss the play they are writing or intend to write. 3 credits.

42.370 Contemporary American Fiction

Discusses novels and short fiction from World War II to the present. 3 credits. Area II.

42.379 Aging, Illness, and Death

Serves as a comparative study of attitudes toward aging, illness, and death as portrayed in selected literary works examined in their historical and cultural contexts. 3 credits.

42.381 The Existential Hero

Studies the development of the existential hero in selected works by Stendahl, Melville, Dostoevsky, Hemingway, Gide, Sartre, Camus and Beckett. 3 credits.

42.382 Crime in Literature

Offers a study of how various authors use crime as a plotting device to study character, reveal social order, and criticize social institutions. 3 credits. Area II.

42.410 Editing and Publishing Techniques

Presents students with the opportunity to study and apply basic editorial techniques within the context of present-day journalism and publishing practices. 3 credits. Prerequisite: Previous enrollment in an appropriate introductory level course, its equivalent, or permission of instructor.

42.411 Desktop-Publishing Laboratory

Advanced word-processing and computer-assisted proofing and page layout. Desktop technology related to printing, including font manipulation and graphic design. 1 credit.

Environmental Sciences

87.111 A Planet at Risk

Presents material designed to foster an understanding of the important natural systems that control the planet and the way in which these are affected by human activity. The course will consider such aspects as energy, natural resources, and food supply which directly impact human populations as well as the regulatory framework that seeks to control environmental impact. 3 credits.

87.115 Astronomy

Offers an introduction to the study of astronomy including historical development, instruments, solar system dynamics, planetary evolution, stellar systems and stellar evolution. Several field trips are included. 3 credits. Area III.

88.101 World and Regional Geography

Surveys the significance, characteristics, and principal geographic problems of the world's major regions. 3 credits. Area I.

89.101 General Geology I

Presents a study of the earth with emphasis on earth materials, earth structure (crustal and internal), earth history and the development of life. Designed for the general student. 3 credits. Area III.

89.102 General Geology II

Studies the earth with emphasis on the surface of the earth and landform development. Includes special topics introducing the student to recent geological research and applied geological knowledge. Designed for the general student. 3 credits. Area III.

93.141 Weather and Climate

Serves as a general meteorology course for the non-science major. Topics include: atmospheric composition, solar radiation, temperature, moisture and condensation relationship between air pressure and wind, weather patterns, severe weather, optical phenomena in the atmosphere, and the behavior and possible change of climate. 3 credits. Area III.

93.211 Atmospheric Science

Focuses on the origin, thermal structure and composition of the atmosphere; atmospheric and solar radiation, atmospheric heat budget; elements of atmospheric thermodynamics and hydrodynamics; equation of state; first law of thermodynamics;

hypsometric equation; geostrophic and gradient motion; and thermal wind. Cyclones, anticyclones, fronts, waves, and jet streams. Global circulation, climate, elements of climatic change, pollution and its effect on weather and climate. 3 credits. Prerequisites: 92.131 and 95.144.

Finance

61.301 Business Finance

Addresses the principles of financial management, including working and fixed capital, sources of funds, financial statements, financial planning and capital structure. 3 credits. Prerequisite: 49.202 and junior standing. (Offered in summer only; limited to students enrolled in American Assembly of Collegiate Schools of Business)

61.302 Money and Banking

Discusses the evolution of money and credit and their role in the economy. Monetary policy and the Federal Reserve System. Structure and function of the commercial banking system and the role of other financial institutions. 3 credits. Prerequisite: 49.202. (Offered in summer only; limited to students enrolled in American Assembly of Collegiate Schools of Business)

History

43.101 Classical Civilization

Studies the political, social and cultural history of the Graeco-Roman world from the age of heroes to the fall of the Roman Empire. (Not open to History concentrators.) 3 credits. Area II.

43.105 Western Civilization to 1715

Traces the major forces in the development of European history from the fall of the Roman Empire to 1715. 3 credits. Area II.

43.106 The Modern World

Examines the major forces in the development of modern European history from the French Revolution to the present. 3 credits. Area II.

43.111 United States History to 1877

Traces the development of American history and institutions from colonization to the end of Reconstruction. Not open to history concentrators. 3 credits. Area II.

43.112 United States History Since 1877

Examines significant developments in American history from the end of the Reconstruction period to the present. Not open to history concentrators. 3 credits. Area II.

43.206 American Economic History

Studies the growth and development of the American economy from its European origins to the present. 3 credits. Area II.

43.210 History of American Popular Culture

An investigation of the social content and institutional character of mass culture in America since 1850. 3 credits. Area II.

43.242 The Second World War

Presents a general survey of the war, together with a closer examination of selected topics. 3 credits. Area II.

43.270 Women in American History

Studies women as a social group in American History. 3 credits. Area II.

43.272 The American Indian

Discusses the American Indian before the introduction of white European civilization. The course examines the history and culture of selected tribes of several regions within the present boundaries of the United States. 3 credits. Area II.

43.277 Ethnic Groups in American Life

Examines the importance of ethnic groups in American history. The course will treat several major ethnic groups and their assimilation or non-assimilation into American life. Fieldwork and research on ethnic groups in the Merrimack Valley is expected. 3 credits.

43.279 History of Lowell

Examines the history of industry, politics and the culture of the city of Lowell. 3 credits.

43.363 Recent U.S. History, 1940 to the Present

Discusses the involvement of the U.S. in World War II, which marked a major turning point in American history. This ushered in decades of Cold War tensions, the militarization of society and participation in foreign alliances and limited wars. Anti-communist conservatives, militant Blacks and a New Left polarized politics and produced a contemporary crisis of confidence in American society. 3 credits. Area II.

43.364 War and Cold War: United States History in the 1940's and 1950's

Offers an in-depth examination of the economic, political, social, and cultural consequences of World War II and the development of the Cold War. 3 credits. Area II.

43.365 United States History Since 1960

Discusses cold War politics and civil rights upheavals during the 1960's and 1970's, the decline of American economic and political power, and the resurgence of conservative politics in the 1980's. 3 credits. Area II.

43.369 Russia in the 19th and 20th Centuries

Addresses selected topics in modern Russian history: political and social reforms of the nineteenth century, international policies in Europe and Asia, the 1917 revolutions, development of the new regime under Lenin, Stalinist policies, World War II and Russian expansion. A comparative study of these topics will underscore patterns of continuity in both Tsarist and Communist Russia. 3 credits. Area II.

43.380 Work and Society

Provides a survey of labor history from the colonial period to the present focusing on the interrelationship between culture and work in American society and on the dynamics of technical and economic changes on the organization of work processes. 3 credits.

43.382 The American West

Involves readings and discussions of the history of the American frontier and the place of the frontier in American society and thought. 3 credits.

Interdisciplinary Courses

59.203 Technology and Human Values I

Serves as a team-taught course about the interrelationship of technology and human values. It begins with an exploration of the Industrial Revolution in Lowell, followed by an examination of topics drawn from areas such as: agriculture, third world development, population control, energy and natural resources, household technology, and transportation. Unifying themes are the values associated with science and technology, the role and responsibility of the scientist and technologist, and the question of whether scientific and technological development should be and can be controlled. 3 credits. Area I and Human Values.

59.204 Technology and Human Values II

Serves as a continuation of 59.203. 3 credits. Area I and Human Values.

59.205 Human Values in Western Culture I

Addresses some of the important questions of human existence through a close study of representative literary, philosophical and religious texts from ancient times to the present, as well as relevant modern works in the behavioral and political sciences. In the first semester, the students explore and evaluate three perennial themes: the problem of evil, self and society, and freedom and fate. 3 credits. Area II and Human Values.

59.206 Human Values in Western Culture II

Serves as a continuation of 59.205. In the second semester, the thematic units are the pursuit of knowledge, the nature of humankind and the experience of love. May be taken independently of 59.205. 3 credits. Area II and Human Values.

59.208 Western Cultural Heritage I

Explores how the actual development of a culture proceeds on many levels at once; the art, literature, philosophy and social structure of a given historical period evolve together, interact with one another, and eventually give rise to a new era. These courses are designed to capture the richness of the various periods of western civilization, to discern networks

of dependency and influence among the diverse aspects of epoch's culture and to trace lines of continuity between one age and another. The first semester will treat the period from ancient civilization to the Protestant reformation; the second semester will focus on developments from the seventeenth through the twentieth centuries. 3 credits. Area II.

59.209 Western Cultural Heritage II

Serves as a continuation of 59.208. May be taken independently of 59.208. 3 credits. Area II.

Languages

Beginning and intermediate courses at the 101-102 and 211-212 levels must be taken for two (preferably consecutive) semesters and in the prescribed sequence. College credit may not be granted for one semester of such courses unless exception is permitted by the Chairperson of the Department of Languages on the basis of student placement in a more advanced language course.

50.101 Beginning French I

Provides instruction in the development of fundamental skills in oral expression, aural comprehension, reading and writing. Tapes available for laboratory use. Students who have completed more than one year of French at the secondary level are ineligible for this course. 3 credits.

50.102 Beginning French II

Serves as a continuation of 50.101, which is a prerequisite. 3 credits.

50.211 Intermediate Conversational French I

Reviews basic grammatical structures and idiomatic patterns with emphasis upon increased proficiency in oral expression and aural comprehension. This course is intended for students who have completed two years of high school French, preferably during their junior and senior years, or for students who have completed 50.102. 3 credits. Area II.

50.212 Intermediate Conversational French II

Serves as a continuation of 50.211, which is a prerequisite, with emphasis on continued development of comprehension and conversational skills. 3 credits. Area II.

50.221 Reading and Conversing in French I

Emphasizes development and conversational skills, selected contemporary works provide the basis for developing conversational comprehension and composition skills. This course is intended for students with a solid foundation in the French language which has been gained from at least three years of high school study immediately prior to admission to the University. 3 credits. Area II.

50.222 Reading and Conversing in French II

Offers a continuation of 50.221 with emphasis upon continued development of reading and conversational skills. 3 credits. Prerequisite: 50.221. Area II.

50.374 Classics of French Cinema

Provides a survey of characteristic styles in French cinema since 1930. The poetic imagination of Cocteau and Carne, the classicism of Renoir, the ironic romanticism of Truffaut, and the revolutionary spirit of Godard presented in their cultural and esthetic context. Films shown with English subtitles. Discussions and readings in English. 3 credits. Prerequisite: Sophomore standing.

51.101 Beginning German I

Offers instruction in the development of fundamental skills in oral expression, aural comprehension, reading and writing. Tapes available for laboratory use. Students who have completed more than 1 year of German at the secondary level are ineligible for this course. 3 credits.

51.102 Beginning German II

Serves as a continuation of 51.101, which is a prerequisite. 3 credits.

51.211 Intermediate German I

Reviews German grammar and syntax with emphasis upon increased proficiency in reading, aural comprehension and oral expression. This course is intended for students who have completed two years of high school German, preferably during their junior and senior years, or for students who have completed 51.102. 3 credits. Area II.

51.212 Intermediate German II

Serves as a continuation of 51.211, which is a prerequisite, with emphasis upon continued development of comprehension and conversational skills. 3 credits. Area II.

51.491 Directed Study in German Literature

Requires individual research projects for modern languages. Students, through regular and frequent consultation with their instructor, develop a course of directed study in German literature and define a problem for individual research. The student's findings are presented in a paper of significant proportions. 3 credits. Prerequisite: permission of instructor.

51.492 Directed Study in German Composition

Requires individual research projects for Modern Language majors. Students, through regular and frequent consultation with their instructor, pursue a special problem of composition or creative expression. 3 credits. Prerequisite: permission of instructor.

52.325 Italian American Literature and Culture

Discusses the most prominent authors and works of Italian American Literature as they, by using the ethnic setting, are able to convey universal human concerns and themes. The discussion on Italian American ethnic issues will include such films as *The Godfather*, *Moonstruck*, *The Sicilian*, *Goodfellas*, and *The Untouchables*. Conducted in English. 3 credits. Area II.

52.378 Italian Cinema and Culture

Gives students a comprehensive knowledge of Italian culture and civilization through the contemporary works of the most prominent Italian film directors and the exchange of ideas in the fields of fiction and fine arts. 3 credits. Area II and Human Values.

53.101 Beginning Japanese I

Designed for Beginning Japanese students who have not had any instruction in Japanese. The course will cover basic Japanese vocabulary and grammar. The students will also learn the characters of Hiragana, Katakana and will be introduced to some kanji. 3 credits.

53.102 Beginning Japanese II

Serves as a continuation of Beginning Japanese. Students will continue to build vocabulary and learn more advanced grammar. In addition, students will continue with reading and writing exercises and learn more kanji. 3 credits. Prerequisite: 53.101 or permission of instructor.

53.103 Beginning Russian I

Introduces the basics of Russian grammar, designed for students with no previous knowledge of Russian. Intensive speaking practice in grammar structures, using naturally occurring conversational patterns. Introduction to the speech conventions of social exchanges. One hour per week devoted to the reading and discussion of stories, biography and poetry. Course will include at least one session with a Soviet citizen, for purposes of conversation practice and cultural discussion. 3 credits.

53.104 Beginning Russian II

Emphasizes the development on vocabulary and oral expression with continuing work on essential Russian grammar. Includes practice in speech etiquette of social situations. Vocabulary reinforced through reading and discussion of stories and poetry. 3 credits. Prerequisite: 53.103 or permission of instructor.

53.105 Chinese Civilization and Culture

Considers Chinese culture and civilization up to the present. Through audiovisual aids, demonstration, field trips, current periodicals and selected readings, the student will explore the Chinese way of being, thinking and living. Emphasis is placed on artistic contributions (martial, culinary, painting and calligraphy) and languages of China to the Western World. 3 credits.

54.101 Beginning Spanish I

Provides instruction in the development of fundamental skills in oral expression, aural comprehension, reading and writing. Tapes available for laboratory use. Students who have completed more than one year of Spanish at the secondary level are ineligible for this course. 3 credits.

54.102 Beginning Spanish II

Serves as a continuation of 54.101, which is a prerequisite. 3 credits.

54.211 Intermediate Conversational Spanish I

Reviews Spanish grammar and syntax with emphasis upon increased proficiency in aural comprehension and oral expression. This course is intended for students who have completed two years of high school Spanish, preferably during their junior and senior years, or for students who have completed 54.102. 3 credits. Area II.

54.212 Intermediate Conversational Spanish II

Serves as a continuation of 54.211, which is a prerequisite, with emphasis upon continued development of comprehension and conversational skills. 3 credits. Area II.

54.221 Reading and Conversing in Spanish I

Emphasizes Spanish grammar review and the development of reading and conversational skills. Selected contemporary works provide the basis for developing conversational comprehension and conversational and composition skills. This course is intended for students with a solid foundation in the Spanish language which had been gained from at least three years of high school study immediately prior to admission to the University. 3 credits. Area II.

54.222 Reading and Conversing in Spanish II

Serves as a continuation of 54.221, which is a prerequisite, with emphasis upon continued development of reading and conversational skills. Required of Spanish concentrators. 3 credits. Prerequisite: 54.221. Area II.

54.234 Advanced Spanish Grammar and Syntax

Studies complex grammatical and syntactical problems systematically. Reviews more advanced problems. 3 credits.

54.245 Advanced Spanish Conversation

Presents advanced oral fluency in rapid and idiomatic speech. Topics of contemporary significance will be selected from contemporary prose. 3 credits.

54.254 Topics in Conversational Spanish

Discusses a wide spectrum of contemporary topics with the object of continuing to develop facility and accuracy of expression. 3 credits. Prerequisite: advanced level proficiency.

54.301 Introduction to Spanish Literature

Studies the history of Spain's literature in its general trends and through its major writers revealing the complicated series of interactions, conflict and influences which have molded the unique character of the nation. Conducted in Spanish. 3 credits. Prerequisite: permission of instructor.

54.302 Introduction to Latin American Literature

Studies the major writers of Latin America from the indigenist literature to the modernist period. The authors and their works will be placed in their historical, sociological, and literary perspective, thus introducing students to the Latin American world. Conducted in Spanish. 3 credits. Prerequisite: permission of instructor.

54.310 Spanish Civilization and Culture

Considers Spanish culture and civilization up to the present. Through audiovisual aids, current newspapers and selected readings, the student will explore the Spanish way of being, thinking, and living. Emphasis is placed on the main contributions of Spain to the Western world. 3 credits. Area II.

54.313 Fieldwork in the Spanish Community

Involves individual assignments under the sponsorship of local service agencies servicing the Spanish speaking community involving individual family and group contact. Written and oral reports will be in Spanish. 3 credits. Prerequisite or corequisite: 54.212 or equivalent.

54.315 Latin American Civilization and Culture

Considers significant intellectual, artistic, historical and sociopolitical aspects of Latin America from the beginning of its history. Through audiovisual aids and selected readings, the student will explore the way of being and expressing of Latin America. 3 credits.

54.320 Special Topics in Spanish Studies

Focuses on a limited topic of special interest in culture, civilization, or literature. May be taught in English or in Spanish. Course content and approach will vary depending on instructor. 3 credits. Prerequisite: permission of instructor.

54.401 Selected Authors

Presents an intensive study of the works by a few Spanish and/or Latin American authors. 3 credits.

54.409 Twentieth Century Spanish Literature

Studies the famous generation of 1927 and of the major literary trends during and after the Spanish Civil War. 3 credits. Prerequisite: 54.350† or permission of instructor.

54.410 Realism and the XIX Century Spanish Novel

Offers a study of fundamental aspects of life, thought, land itself and its sense of history as reflected in the literary masterpieces of Valera, Galdos, Alarcon, Pereda and others. An analysis of the literary techniques and fiction of the Realism will be included. 3 credits. Prerequisite: 54.315 or permission of instructor.

54.412 The Short Story in Latin America

Provides an analytical examination of the thematic and linguistic structures in major Latin American short story writers such as Borges, Cortazar, Marquez, Rulfo. 3 credits. Prerequisite: 54.350 Introduction to Literary Analysis† or permission of instructor.

56.101 Beginning Latin I

Serves as a course for beginners and for students wishing to review the elements of Latin and to acquire, thereby, an ability to read selected passages from Latin authors. 3 credits.

56.102 Beginning Latin II

Serves as a continuation of 56.101 with special attention devoted to the translation, analysis, and class discussion of selected passages from Latin authors illustrating the life, culture, and contribution of ancient Rome to the modern world. 3 credits.

Legal Studies

41.103 Introduction to Paralegal Studies

Familiarizes students with the role of a paralegal in both the public and private sector. Other topics will include principles of jurisprudence and basic legal concepts and terminology. 3 credits.

41.261 Introduction to Legal Concepts

Serves as an introductory legal course. It is a survey of many specific topics such as product liability, consumer law, intellectual property, and ethics. More importantly the course emphasizes critical legal thinking and human values. 3 credits. Area I.

41.262 Introduction to Business Law

Introduces the student to the fundamentals of criminal and tort law. The main emphasis is on all aspects of contract law including the agreement consideration, the writing third party rights, illegality, performance, and remedies. Also covered is agency law concerning all situations where one party is working for another in the business world. This course is highly recommended for pre-law students, CPA's and paralegals. 3 credits

41.363 Corporate and Property Law

Studies the law and its impact on the business world. Partnerships, limited partnerships, and joint ventures are studied at the outset of the course. The main emphasis is on elements of the corporate structure. The last part of the course deals with personal and real property with coverage of wills and trusts. This course is highly recommended for pre-law students, CPA's and paralegals. 3 credits.

41.365 Law and Society

Explores the manager's role in understanding and determining the firm's relations with government and society. Topics relating to government include the tax and regulatory provisions of local, state and federal agencies including such matters as antitrust, mergers and licensing. Topics relating to society include the social cost of business, civil rights, business ethics, and problems in ecology. 3 credits. Human Values.

41.366 International Law

Introduces the body of international rules, customs and regulations which are in force between nations. Specific legal issues involving a study of multinational, cultural, political, economic and ethnic perspectives are addressed. Topics covered include human rights, war prevention, foreign policy, tort and criminal liability, business trade practices, and dispute settlement. Recommended at the senior level. 3 credits.

41.367 Environmental Law and Regulations

Provides an introduction and overview of the laws and policies that have shaped environmental protection in the United States. The course begins with an examination of the assumptions and perspectives that have formed the basis for government policy

† Offered through the day school. See UMass Lowell's Undergraduate Catalog for course description.

and then moves to an examination of the primary government programs. Each program is reviewed in terms of its problem definition, program objectives, and results. The course concludes with a consideration of the new policy directions which are shaping the future. 3 credits.

41.369 The Courts and the Constitution

Focuses on the separation of powers of the national government and the limitation of national power to preserve a degree of autonomy in the states. These dispersions of power which have guaranteed fundamental individual liberties are examined by reading leading U.S. Supreme Court cases. Students will explore how their freedoms to make moral choices are affected by the law of the constitution. 3 credits.

41.370 Real Estate Law

Examines contracts for the sale of real estate, deeds, title examinations, security for real estate transactions, methods and problems of co-ownership, zoning ordinances, brokerage contracts, leases and landlord and tenant rights and liabilities. 3 credits.

41.376 Family Law

Studies the critical family law issues facing society today. Subject matter examined includes the law of marriage, custody, adoption, divorce, child support, juveniles, right to die, fetal tissue transfer to prolong the life of another, reproduction control and surrogate parenting. This course is taught from a legal and human values perspective. 3 credits.

41.381 Women and the Law

Presents issues that particularly affect women. Topics include: sex discrimination, sexual harassment, marriage, divorce, reproductive control, "surrogate motherhood", and custody. 3 credits.

41.387 Legal Research Methods

Stresses the development of the ability to read and analyze judicial decisions, do legal research and manipulate legal doctrine. This course also involves extensive case readings and library research. 3 credits.

41.390 Litigation

Examines the practices and procedures involved in the litigation process. Topics include: legal research, courts and jurisdictions, evidence and discovery, pleadings, motions, depositions, trials and appeals, and federal rules of procedure. 3 credits.

41.391 Federal Taxation Law

Discusses Federal and State Law Tax for individuals, partnerships, and corporations. Also covers effective decisions on timing of income, expenses, and capital investments, and the structure of the Internal Revenue Code, regulations, and court decisions in the framework of the evolution of the Federal and State Tax Law. 3 credits.

Management

62.201 Marketing Principles

Addresses the role of marketing in the economy. The elements of the marketing mix - product, price, distribution, and promotion - are discussed in the context of social and political constraints on marketing activity. 3 credits. Prerequisites: 49.201, 48.101, 47.101.

69.201 Principles of Management

(replaced by 69.253)

69.226 Sales Management

Discusses management of the personal selling function. Principles of sales force organization, selection, training, compensation supervision and motivation are explored via appropriate cases. 3 credits.

69.231 Business Finance

Presents the principles of financial management, including working and fixed capital sources of funds, financial statements, budgeting and capitalization. 3 credits. Prerequisites: 67.102, 49.201, 49.202.

69.232 Money and Banking

Discusses the evolution of money and credit and their role in the economy. Monetary policy and the Federal Reserve System will be covered. Structure and function of the commercial banking system and the role of other financial institutions are also discussed. 3 credits. Prerequisites: 49.201, 49.202.

69.234 Investment Management

Presents the principles of investment: security analysis, portfolio management and market analysis. 3 credits. Prerequisite: 69.231.

69.251 Personnel Management

Discusses recruitment, selection and training of the work force. Wage and salary administration, employee health and safety, welfare and education are all covered. 3 credits.

69.253 Introduction to Management and Organizational Behavior

(replaces 69.201)

Presents applications of concepts from the behavioral sciences to individual and group activity in organizations. Use of behavioral concepts to introduce and implement organizational change will be discussed. 3 credits. Prerequisite: 47.101.

69.271 Operations Management

Presents the principle of production/operations management. Nature and function of production systems, operation planning and control, plant layout, materials handling, inventory and quality control are all covered. 3 credits. Prerequisite: 49.211.

69.275 Total Quality Management

Views quality control from the total or company-wide perspective. The course contains traditional material on statistical process control (SPC), quality cost, quality assurance, quality information systems as well as the recent management theories and ideas of Deming, Jurand, Ishikawa and Taguchi. 3 credits.

69.276 Entrepreneurial Management of New and Small Enterprises

Explains the four key elements of successful entrepreneurship: deciding what business to be in; organizing; financing and marketing; developing the ability to design and implement a business plan. Topics include raising venture capital, answering legal and tax questions, assessing the feasibility of a new venture, selling, motivating, and negotiating. Includes readings and case studies. 3 credits.

69.277 Leadership in Management

Provides students with the opportunity to examine and evaluate effective leadership in organizations. It assesses the differences between a manager and a leader, and delineates between various managerial roles, including liaison, monitor, resource allocator, as well as various leadership styles, including the behavioral, situational and transformational models. 3 credits.

69.281 Purchasing Principles

Familiarizes students with how an industrial purchasing department acquires materials and services, either domestically or globally, of the right quality, in the right quantity, at the right price, at the right time, from the right source. The course will familiarize the student with the basic tasks required of an

industrial purchasing department and how these activities contribute to the effective and efficient management of the firm. The Purchasing Principles course consists of four major modules; procurement practices; administration of purchasing departments; materials and logistics management; and current issues and trends in purchasing. 3 credits.

69.282 Negotiations in Purchasing

Provides the student with an opportunity to understand and improve their ability to negotiate and persuade with a typical context found in business buying and selling. The course is composed of three basic elements—preparation for negotiations, development of an understanding of the actual process of negotiation, and actual practice in negotiations. Preparation for negotiations stresses the development of information that determines the facts and opinions that will be injected into the negotiation process—in short, understanding the goals and needs of both parties. The process of negotiations will focus on developing constructive ways to come up with agreements that fulfill the requirements of the negotiating parties. And most importantly, the course provides students with the opportunity to develop their own negotiation skills and styles via role playing exercises. 3 credits.

Mathematics

All mathematics courses, including those designated as Computer Mathematics Option courses except 90.010 and 90.111 are transferable to the UMass Lowell day division upon appropriate University approval. Courses with the prefix 92. are equivalent to those in the day school with the same number. Day school students wishing to elect courses with the prefix 90. must consult the chairperson and/or coordinator in order to determine course equivalence.

90.010 Introductory Mathematics

Serves as a transitional course designed for students with a limited mathematics background. The main purpose of this course is to give students an insight into the structure of basic mathematics, including algebra, and to increase the students' manipulative skills in this area. 3 credits.

90.111 Fundamentals of Algebra

Intended for students with little or no background in basic algebra or whose background is not current. Topics covered include: the real number system, factoring fractions, linear equations, functions, graphs, systems of equations, and the quadratic equation. 3 credits.

Note: 90.010 and 90.111 may not be used as electives in any University degree programs.

90.112 Concepts in Algebra I

Designed for students whose background in basic algebra is current. The emphasis is on applications to the management and social sciences. Topics covered include: an introduction to set notation, equations, inequalities, functions, and matrices. Credit is not given for both 90.112 and 92.121. 3 credits. Prerequisite: 90.111 or satisfactory score on the Math Placement Exam given the first week of class.

90.119 Concepts in Algebra II

Serves as a continuation of 90.112. Topics covered include quadratic functions, the mathematics of finance, linear programming, optimization and an introduction to differential calculus. 3 credits. Prerequisite: 90.112.

92.110 College Algebra

A review of algebra with the goal of enhancing the student's understanding of basic mathematics. This course lays the groundwork of further courses such as Mathematical Perspectives and Introduction to Statistics. For liberal arts majors only. 3 credits. Area III.

92.111 Mathematical Perspectives

Provides an introduction to the nature of mathematics, providing insights into what mathematics is, what it accomplishes, and how it is pursued as a human enterprise. Concepts and relevance to modern experience will be stressed with topics drawn from areas such as inductive and deductive reasoning, number systems, algebra, geometry, probability, and statistics. 3 credits. Prerequisite: Two years of high school algebra. No credit toward a degree in science or engineering. Area III.

92.115 College Trigonometry

Reviews angles and their measure, the trigonometric functions, solving triangles, law of sines, law of cosines, circular functions and their graphs, vectors and trigonometric identities. 3 credits. Prerequisite: 92.121.

92.121 Precalculus Mathematics

Intended for students whose background in basic algebra is current. The course objective is to provide students with the problem solving and computational techniques needed for further coursework and in their occupation. Topics covered include: linear equations, slope of a line, quadratic equations, functions, transformations, inequalities, curve sketching, systems of equations, and the exponential and logarithmic functions. Credit is not given for both 92.121 and 90.112. 3 credits. Prerequisite: 90.111 or satisfactory score on the Math Placement Exam given the first week of class. Area III.

92.122 Differential Calculus

Focuses on differential calculus: limits, continuity, derivatives, differentials, higher-order derivatives, implicit differentiation, maxima and minima of functions, and applications of derivatives to business and economics. Prerequisite: 92.121. Area III.

92.125 Calculus A

Serves as a first course in calculus and provides a brief review of analytic geometry and trigonometry. The course progresses to the study of limits, derivatives, rules for differentiation of algebraic and transcendental function, chain rule, implicit differentiation, continuity, related rate problems, max/min problems, and curve sketching. 3 credits. Prerequisite: 92.115.

92.126 Calculus B

Serves as a continuation of 92.125. The course covers integration, rectilinear motion, sigma notation, area, area between two curves, volumes by disc and shell methods, length of a plane curve and surface area, natural logarithm, the exponential function, hyperbolic functions, inverse functions and inverse trigonometric functions, integrals and derivatives of the inverse trig. functions, and integration formulas. 3 credits. Prerequisite: 92.125.

92.127 Calculus IA

Presents a review of precalculus algebra and trigonometry integrated with the first half of Calculus I. Functions, limits, continuity, the derivative, the chain rule, related rate problems. For technical degree programs, including Mathematics, only two credits of this course may be applied toward a degree. 4 credits. (Offered in summer only.)

92.128 Calculus IB

Provides a review of precalculus algebra and trigonometry integrated with the second half of Calculus I. Implicit differentiation, max/min problems, and curve sketching. Integrals and areas. 4 credits. Prerequisite: 92.127. For technical degree programs, including Mathematics, only two credits of this course may be applied toward a degree. For prerequisites, completion of this course is equivalent to 92.131. (Offered in summer only).

92.131 Calculus I

Serves as a first course in calculus. Functions, limits, continuity, derivatives, rules for differentiation of algebraic and transcendental function; chain rule, implicit differentiation, related rate problems, max/min problems, and curve sketching. Integrals and areas. 4 credits.

92.132 Calculus II

Serves as a continuation of Calculus I. Volume, arc length, surface area, pressure and force. Differentiation and integration of trigonometric, inverse trigonometric, exponential, logarithmic, and hyperbolic functions. Improper integration, infinite series, Taylor and MacLauren series. 4 credits. Prerequisite: 92.131.

92.183 Introduction to Statistics

Reviews descriptive statistics including central tendency, variability, graphing and data analysis; probability laws, discrete and continuous probability distribution; correlation, regression and Inferential statistics. Extensive use will be made of MINITAB and other software. May not be taken for credit along with 92.283, 92.385 or 92.386. May not be used to satisfy Mathematics major requirements. 3 credits. Area III.

92.201 Integral Calculus

Presents exponential and logarithmic functions, area under a curve, fundamental theorem of calculus, integration by parts, areas between curves, applications of integration to business and economics, differential equations, multivariable calculus, maxima and minima using Lagrange multipliers. Matrix algebra: matrix operations, inverse of a matrix, and solving simultaneous equations and matrices. 3 credits. Prerequisite: 92.122. Area III.

92.221 Linear Algebra I

Explains the basic properties of linear mappings, matrices, scalar products and orthogonality, and systems of linear equations, and introduces proofs and the axiomatic methods through the study of the vector space axioms. Also covers linear dependence and independence, subspaces, basis, and inner products. Applications of the above will also be discussed. 3 credits. Prerequisites: 92.225 and 92.321 or permission of coordinator.

92.222 Linear Algebra II

Discusses linear transformations and matrix representation. Eigenvalues and eigenvectors and the diagonalization problem. The Gram-Schmidt process and orthogonal matrices. Applications of the above as well as additional applications are discussed. 3 credits. Prerequisite: 92.221.

92.223 Survey of Calculus

Surveys the basic concepts in differential and integral calculus. Topics included are techniques of differentiation and integration and applications. This is a one semester course intended to provide a broad appreciation of the topics ordinarily covered in the first two semesters of a calculus course. This course may not be used to replace any required calculus course. 3 credits. Prerequisite: 92.121.

92.225 Calculus C

Serves as a continuation of 92.126. This course covers integration by parts, integration of trigonometric integrals, trigonometric substitution, partial fraction, numeric integration, improper integrals, L'Hopital's Rule, indeterminate forms, sequences, infinite series, integral tests, comparison tests, alternating series tests, power series, Taylor series, polar coordinates, graphs and areas in polar coordinates, and parametric equations. 3 credits. Prerequisite: 92.126.

92.226 Calculus D

Serves as a continuation of 92.225. This course covers vector calculus, curvature, cylindrical surfaces, dot and cross products, curves and planes in three space, cylindrical and spherical coordinates, functions of two variables, chain rule, directional derivatives and gradient, tangent planes and functions of n variables, a double and triple integrals in rectangular, polar, cylindrical and spherical coordinate systems. 3 credits. Prerequisite: 92.225.

92.231 Calculus III

Serves as a continuation of Calculus II. Polar Coordinates, parametric equations, vectors and analytic geometry in space. Functions of several variables, partial derivatives, and chain rule. Tangent planes and normal lines. Maxima and minima, Lagrange multipliers, and multiple integrals. 4 credits. Prerequisite: 92.132.

92.234 Differential Equations

Presents the classification and solution of ordinary differential equations of the first and higher orders. The Laplace transform. Applications. 3 credits. Prerequisite: 92.225 or 92.132.

92.301 Introduction to Applied Mathematics I

Discusses vector analysis, Green's Theorem, Divergence Theorem, Stokes' Theorem, Fourier series, integrals, and partial differential equations of physics and engineering. 3 credits. Prerequisite: 92.226 or 92.231.

92.302 Introduction to Applied Mathematics II

Introduces students to matrix algebra, solution of systems of linear equations, eigenvalues and eigenvectors, solution of differential equations by matrix methods, series solution of differential equations, Bessel and Legendre functions, and Sturm-Liouville problems. 3 credits. Prerequisite: 92.234.

92.305 Introduction to Real Analysis I

Presents real and complex number systems. Sequences and series of complex numbers. Theory of metric spaces: completeness, compactness, continuity, uniform continuity. Differentiability of functions, and Taylor's Theorem. 3 credits. Prerequisites: 92.221, 92.225.

92.306 Introduction to Real Analysis II

Studies the sequences and series of functions, uniform convergence, elementary functions, and the functions between Euclidean Spaces: the derivative as a linear map, the Jacobian, inverse function theorem, implicit theorem, Taylor's theorem. Integration of real valued functions on Euclidean space, fundamental theorem of the integral calculus, and the change of variables formula will also be covered. 3 credits. Prerequisite: 92.305.

92.307 Probability and Mathematical Statistics I

Addresses the topics of probability, random variables, discrete and continuous densities, expectation and variance, special distributions (binomial, Poisson, normal, etc.), moment generating functions, joint and conditional distributions, transformations of variables, sampling, and the central limit theorem. 3 credits. Prerequisite: 92.226

92.308 Probability and Mathematical Statistics II

Discusses point estimation and confidence intervals, hypothesis testing, correlation, linear regression, analysis of variance for the one-and two-way design, nonparametric methods, chi-square tests for contingency tables. 3 credits. Prerequisite: 92.307

92.315 Partial Differential Equations

Explores basic concepts in partial differentiation. Classifications and solution of first order and higher order linear partial differential equations will be discussed. Introduction to Bessel, Legendre and other orthogonal functions, as well as boundary value problems. Application of Fourier Series, Fourier Integrals, and Laplace Transforms will be addressed. 3 credits. Prerequisite: 92.234.

92.321 Discrete Structures I

Presents propositional logic, combinatorics, methods of proof, mathematical systems, algebra of sets, matrix algebra, relations and functions, recursion and generating functions, applications to Pascal, and graph theory. 3 credits. Prerequisite: 90.112 or 92.121.

92.322 Discrete Structures II

Examines graph theory, trees, algebraic systems, Boolean algebra, groups, monoids, automata, finite-state machines, rings and fields, applications to Pascal, coding theory, logic design, and sorting. 3 credits. Prerequisite: 92.321

92.362 Numerical Analysis I

Focuses on the theory and application of numerical techniques including error analysis. Also discusses solution of linear, nonlinear and differential equations, interpolation, numerical integration, and curve fitting. Computer solutions are emphasized. 3 credits. Prerequisites: 92.225 or 92.231, and a programming language.

92.381 Introduction to Operations Research Techniques I

Studies the use of decision models in industrial systems, fundamentals of probability and matrix theory, critical path methods, linear programming, the simplex method, sensitivity analysis, goal programming, transportation and assignment models, and integer programming. 3 credits. Prerequisite: 92.126 or 92.131.

92.382 Introduction to Operations Research Techniques II

Serves as a continuation of 92.381. Topics include: inventory control models, Markov analysis, queuing models, dynamic programming, network analysis, and simulation techniques. 3 credits. Prerequisite: 92.381.

92.386 Statistics for Science and Engineering

Provides a one semester course in probability and statistics with applications in the engineering sciences. Probability of events, discrete and continuous random variables, density functions, distributions. Estimation, hypothesis testing, regression and correlation. May not be taken for credit along with 92.183, 92.283, 92.385, or 49.211. 3 credits. Prerequisite: 92.126 or 92.132.

92.401 Applied Mathematics and Modeling

Studies realistic problems in order to teach students how mathematics can be applied to models and situations existing around us. Examples are population dynamics, traffic flow, epidemics and dynamic problems such as planetary motion and harmonic oscillation. Basic mathematical techniques will be applied, and mathematical models will be "built" to describe particular problem behavior. Solutions can then be interpreted and information can be learned from them. In studying such methods we will expand our knowledge of calculus, linear algebra and differential equations. 3 credits. Prerequisites: 92.226, 92.221 and 92.234.

92.411 Complex Variables I

Discusses complex numbers, functions of a complex variable, mappings, derivatives, analytic functions, elementary functions. Laurent series, residues and poles, contour integration. 3 credits. Prerequisite: 92.226 or 92.231.

92.412 Complex Variables II

Examines transformations, conformal mappings, boundary conditions, applications in heat conduction, electrostatic potential, and fluid flow, gamma and beta functions, Inverse Laplace transform, and Riemann surfaces. 3 credits. Prerequisite: 92.411.

92.413 Number Theory

Studies congruencies and the Chinese Remainder Theorem, Primitive roots, quadratic reciprocity, approximation properties of continued fractions, Pell's equation. Recent application of number theory such as primality testing, cryptology, and random number generation will also be covered. 3 credits. Prerequisite: 92.221 or 92.321.

92.419 Computer Algebra with Mathematica

Mathematica is an extremely powerful computer-based tool for solving problems. Computer algebra systems like *Mathematica* are used by engineers, scientists and mathematicians to assist them in attacking problems that require complicated and involved symbolic or numeric computations. 3 credits. Prerequisites: 92.126 and a programming language.

92.420 Mathematical Problem Solving

Focuses on: mathematical resources, ability to use heuristics, the student's beliefs about the use of mathematics to solve problems, and the student's self-confidence as a problem solver. Effective strategies for incorporating problem solving in the curriculum will also be discussed. 3 credits. Prerequisite: 92.221 or 92.321.

92.421 Abstract Algebra I

Presents elementary group theory, groups, cosets, normal subgroups, quotient groups, isomorphisms, homomorphisms, and applications. 3 credits. Prerequisite: 92.221 or 92.321.

92.422 Abstract Algebra II

Discusses elementary rings and field theory, quotient rings and ideals, homomorphism of rings, rings of polynomials, algebraic extensions, automorphisms of fields, separable extensions, and the Galois Theory. 3 credits. Prerequisite: 92.421.

92427 Geometry

Provides a wide survey of topics related to secondary school geometry; axiomatic systems and Euclidean geometry; constructions in geometry; geometry of vision, perspective and projective geometry; analytic geometry; and historical development. 3 credits. Prerequisite: 92.221 or 92.321

92.435 History of Mathematical Science

Examines ancient numeral systems, Babylonian and Egyptian mathematics, Pythagorean mathematics, duplication, trisection, and quadrature, Euclid's Elements and Greek mathematics after Euclid, Hindu and Arabian mathematics, European mathematics from 500 to 1600, origins of modern mathematics, analytic geometry, the history of calculus. Also covers the transition to the twentieth century and contemporary perspectives. 3 credits. Prerequisite: 92.225 or 92.231.

92.442 Boundary Value Problems

Focuses on partial differential equations of physics and engineering, boundary value problems, Fourier series, convergence tests, Sturm-Liouville problems, orthogonal systems, generalized Fourier series, and Fourier integrals and applications. 3 credits. Prerequisite: 92.301.

92.454 Numerical Analysis II

Serves as a continuation of 92.362 including: numerical solution of ordinary and partial differential equations, boundary value problems, curve-fitting, error analysis and computer solutions. 3 credits. Prerequisite: 92.362.

92.480 Applied Combinatorics

Presents generating functions, recurrence relations, inclusion-exclusion, Polya theory, experimental designs (block design), partially ordered sets, and applications. 3 credits. Prerequisites: Calculus and Discrete Structures.

92.498 Mathematics Seminar

Allows for student reading, writing and criticism of topics from current literature. Review of some important elements of undergraduate work. 3 credits. Prerequisite: permission of coordinator.

Mechanical Engineering

22.214 Engineering Mechanics

Serves as a one-semester terminal course with emphasis on the engineering aspects of mechanics. Topics include vectors, static equilibrium, rigid and deformable solids; stress and strain under various loading conditions, mechanical properties of materials. 4 credits. Prerequisite: 95.144. Corequisite: 92.234. Not open to students majoring in Mechanical Engineering. (Offered in summer only)

22.242 Thermodynamics

Presents a detailed development of the first and second laws as applied to open and closed systems in steady flow. Concepts of work, heat, and energy. Thermodynamic properties of pure substances, condensable vapors, and the perfect gas. The concept of entropy, reversibility and irreversibility. Power cycles. Vapor and air standard cycles. 3 credits. Prerequisites: 25.101†, 25.102†, 95.144 and 92.231. (Offered in summer only)

22.344 Heat Transfer

Discusses the theory and application of steady and transient heat conduction in solids. Mathematical development of thermal boundary layer theory. Forced convection, natural convection. Development of thermal radiation with application to heat exchange between non-black bodies. Heat exchangers, log-mean temperature difference, effectiveness. 3 credits. Prerequisites: 22.381†, 22.361†. (Offered in summer only)

22.441 Analysis of Thermo-Fluid Processes

Focuses on dimensional analysis; similitude and modeling; mixtures of ideal gases; air-water vapor mixtures with application to air conditioning; first law analysis of combustion; flow of a compressible fluid through a variable area passage; and Mach number, choking, and normal shock. 3 credits. Prerequisite: 84.122. (Offered in summer only)

† Offered through the day school. See UMass Lowell's Undergraduate Catalog for course description.

Mechanical Engineering Technology

23.101 Engineering Graphics I

Presents material in both the class and laboratory format, and covers graphical communications, lectures and exercises on the presentation of data and shape, and the description of various mechanical parts. Topics covered include; multi-view sketching and projection, section view, isometric and oblique drawing, dimensioning, and detail drawing. 2 credits.

23.102 Engineering Graphics II

Presents material in both the class and laboratory format, serving as a continuation of 23.101. Topics covered include: primary and secondary views; descriptive geometry of lines, points, planes and intersections; tolerancing; details and assembly drawing; and parts listing and symbols. 2 credits. Prerequisite: 23.101.

23.200 CADrf (Computer Aided Drafting)

Presents computer drafting concepts in a lecture/laboratory format. Using a personal computer based software package, students will create engineering drawings based on standard orthographic projections. Multi-view two-dimensional through three-dimensional drawing will be presented. This is an introductory level course and requires little or no computer proficiency. 3 credits. Prerequisite: 23.102.

23.202 Thermo/Fluids Laboratory

Presents the fundamentals of measurements in the general areas of thermodynamics and fluid mechanics. Laboratory topics include flow measurement of air and steam, critical flow through an orifice, fluid flow in pipes and pumps, tests of heat exchangers, gas turbines, internal-combustion engines, and refrigeration cycles. 2 credits. Prerequisites: 23.241, 23.242, 42.226.

23.221 Statics (MET)

Discusses the fundamentals of statics. Topics covered include vector algebra, force, resultants, moment of a force, friction, area and mass moment of inertia, and static equilibrium of rigid bodies. 3 credits. Prerequisites: 92.125, 99.131, 92.263.

23.222 Dynamics (MET)

Explains the laws of kinematics of particles and rigid bodies involving absolute and relative motion. Principles of work and energy, impulse and momentum

are also addressed. 3 credits. Prerequisites: 92.126, 23.221.

23.223 Mechanics of Materials I

Presents stress and deformation analysis of bodies under axial, torsional, flexural and combined loading. Also covered are principle stresses, Mohr's stress circle, strain, temperature effects, and shear and moment diagrams. 3 credits. Prerequisites: 92.126, 23.221.

23.241 Elements of Thermodynamics I

Studies the first and second laws as applied to a thermodynamic system. The concepts of heat and work; thermodynamic properties of liquids, vapors, and gases; and perfect gas laws are discussed. The use of thermodynamic tables and charts will also be presented. 3 credits. Prerequisites: 92.126, 99.132, 92.263.

23.242 Applied Fluid Mechanics

Addresses the properties of fluids, and basic concepts of continuity, momentum, hydrostatics and fluid flow kinematics. Analysis of flow of real fluids in pipes, ducts and open channels is conducted. Study of compressible flows, fluid couplings and torque converters as well as flow measurement techniques will also be discussed. 3 credits. Prerequisites: 23.222, 92.263.

23.243 Elements of Thermodynamics II

Presents the application of thermodynamic principles. Vapor and gas cycles, refrigeration and energy conversion are covered. The concepts of availability and irreversibility will also be addressed. 3 credits. Prerequisite: 23.241.

23.262 Engineering Data Analysis

Examines methods of statistical data analysis useful for manufacturing engineering. Topics include: probability, hypothesis testing, curve fitting, correlation, sampling, and applications to quality assurance. 3 credits. Prerequisite: 92.126.

23.295 Materials Science

Studies the mechanical, electrical, thermal, chemical and magnetic properties of the materials, and the dependency of these properties on the crystal structure and atomic arrangement. Methods of altering the structures of materials to obtain desired properties will also be presented. 3 credits. Prerequisites: 84.121, 99.132.

23.301 Manufacturing Technology Lab

Presents fundamentals of manufacturing processes, with emphasis on machine shop operations. Problems in design, tooling and production aspects of manufacturing. Hands-on applications in a combined class and laboratory format. Assumes basic knowledge of mechanical drawing. 2 credits. Prerequisite: 23.102.

23.302 Mechanics/Materials Laboratory

Presents hands-on experiments that cover statics, dynamics and mechanics of materials. Topics include: concepts of strain gages, tension test, rotating motion, columns and beams, principle of stresses, rigid body dynamics, torsion, surface hardness, and relative motion. 2 credits. Prerequisites: 23.222, 23.223, 42.226.

23.305 Manufacturing Processes

Introduces the student to various processes used by modern industry in the creation of a product. Basic manufacturing organization and concepts are also covered. Topics include EDM, ECM, lasers, casting, forming, chemical machining, finishing and abrasives. Assumes basic knowledge of mechanical drawing and machine tools. 3 credits. Prerequisite: 23.301 or equivalent.

23.306 Electronics Manufacturing Technology

Introduces an array of state-of-the-art manufacturing processes for the manufacture of electronic components. Product characteristics, assembly, fabrication, soldering, testing, and quality metrics are among the areas studied. Manufacture of printed circuit boards is covered in detail. 3 credits. Prerequisite: 23.301 or equivalent.

23.310 Industrial Safety

Provides a practical study of industrial safety and accident prevention. Course material includes hazard analysis, safety management, technological remedies and risk management. Numerous practical cases are presented and the roles of governmental agencies in safety are analyzed. 3 credits.

23.314 Manufacturing Productivity (Total Quality in Manufacturing)

Discusses an engineering approach to the total quality concept, quality and productivity enhancement

techniques, including participative management, group problem solving, process charts, cause-effect diagrams, pareto analysis, time study, QFD (Quality Function Deployment), Just-In-Time manufacturing, Kanban, Kaizen (continuous improvement), ISO 9000 standards, and Quality Awards. The contribution of Taylor, the Gilbreths, Shewhart, Deming, Ishikawa, Feigenbaum, Jurand, Shingo, and others will be examined. 3 credits.

23.318 Logistics Engineering

Provides an introduction to the field of logistics. This course identifies the elements and measures of logistics (including definitions and concepts), studies logistics in the context of the system life cycle from design to disposal, and identifies the interrelationships between the various elements of system/product support. 3 credits. Prerequisite: 23.262 or 92.386 or equivalent.

23.320 Machine Design

Presents material in both class and laboratory. Application of theories of failure, mechanics of materials and dynamics to the analysis and design of typical machine elements, such as shafts, springs, screws, belts, pulleys, keys, and gears are covered. Problems assigned also illustrate synthesis of ideas applied to design. 3 credits. Prerequisites: 23.222, 23.223.

23.354 Problems in Mechanical Engineering Technology

Provides a review and extension of applied mechanics. Analytical as well as computer aided solutions to the problems in statics, dynamics, and machine design will be addressed. 3 credits. Prerequisites: 23.320, 92.225, 92.263.

23.402 Engineering Measurement Laboratory

Presents hands-on experiments that are designed to teach the fundamentals of instrumentation devices, experimental techniques and basic physical principles of mechanical systems. The student: 1) assembles measurement systems including transducers, signal conditioners and data acquisition systems; 2) conducts experiments on simple mechanical systems; and 3) validates the data by analyses. Effective written communication techniques are emphasized. 2 credits. Prerequisites: 23.222, 23.241, 23.242.

23.405 Senior Project

Involves the application of the student's engineering training to a practical problem. The project is judged based on the planning, executing, oral and written progress report, and final report. Work may be individual or a team effort, depending upon the complexity of the project. 3 credits. Prerequisite: Senior status.

23.408 Microprocessors

Presents industrial applications of microprocessors with emphasis on the use of microprocessors in programmable controllers. (Lab included.) 3 credits.

23.414 Engineering Economics

Offers an analysis of available alternatives in equipment, plant and materials purchasing or leasing. Economic feasibility analysis of industrial projects including depreciation techniques, break-even analysis, benefit-cost techniques, replacement, present worth and rate of return analysis will be covered. 3 credits. Prerequisite: 49.201.

23.416 Statistical Quality Control

Studies traditional and current statistical techniques applied to the solution of quality problems and quality improvement activities. Topics include an examination of the development of SQC as a discipline, statistical evaluation, process stability, process capability, design and use of control charts, and sampling plans. 3 credits. Prerequisite: 23.262 or 92.386 or equivalent.

23.418 Quality Work Teams

Builds upon the material of 23.416 and applies techniques to the total quality objective. Topics include: planning and leading team meetings, facilitating group participation, problem solving models, developing consensus and action plans, and establishing an innovative team environment. 3 credits.

23.419 Applied Computer-Aided Manufacturing (CAM)

Presents material in both class and laboratory formats. Use of CAM to assist in all phases of manufacturing a product, including process and production planning, machining, scheduling, and quality control. Applications of group technology and cellular manufacturing. A major project is required. 3 credits. Prerequisite: 23.305 or 23.306.

23.426 Quality Systems Certification/ISO 9000

Addresses the Quality System requirements of ISO 9000, the documentation requirements of ISO 10013, and the system auditing requirements of ISO 10011. The student will gain an overall appreciation of these requirements and be able to contribute to the implementation and evaluation of a Quality system. 3 credits. Prerequisite: 23.314.

23.427 Plant Layout and Materials Handling

Studies materials flow and layout of production, assembly and service departments, manufacturing, buildings, and service facilities. Materials handling equipment and packaging techniques are also covered. 3 credits. Prerequisite: 23.305 or 23.306.

23.430 Industrial Automation

Presents automation strategies, economic analysis, high volume automation, automated flow lines, analysis and balancing, CAD/CAM, process control fundamentals and supervision, integrated manufacturing system, product design and assembly machines. 3 credits.

23.450 Reliability Engineering

Introduces reliability and maintainability design techniques, predicting failure rates, data assessment methods, determining MTBF, availability concepts, FMEA, simple reliability models, demonstration testing, government standards and specifications. 3 credits. Prerequisite: 23.262 or 92.386 or equivalent.

23.455 Robotics

Provides a description of robotic systems and their applications. Understanding the basic functions and interactions of robotic subsystems will be encouraged. Students will be expected to perform exercises in programming commercially available robots for classroom demonstrations. Methods for determining the capabilities and limitations of robotic subsystems through analysis and experimentation will also be discussed. 3 credits. Prerequisites: 23.320, 92.263.

23.464 Manufacturing Operations

Combines work on an actual industrial project with class work related to plant layout, project control, and materials management. Several case studies are used to examine these activities. As part of the project, students must contact companies, find a project, undertake the project, and report on all stages of the project. 3 credits.

23.471 Design of Automatic Machinery

Explores basic concepts in design of automated machinery with emphasis on selection and integration of standard components and controls. Fundamentals of pneumatic, relay and microprocessor controls applied to pneumatic, electromechanical and mechanical sensing and actuating components will be presented. 3 credits. Prerequisites: 17.132, 23.320, 92.263.

23.472 Applied Dynamics

Presents statics and dynamics as applied to general system with oscillatory motion. The kinematics of periodic motion and the vibrations of systems with single degree of freedom will be addressed. 3 credits. Prerequisites: 92.226, 23.222, 23.223.

23.473 Mechanics of Materials II

Discusses topics such as: shear center, unsymmetrical bending, energy methods, unit dummy load method, and failure theories. 3 credits. Prerequisites: 92.226, 23.223.

23.474 Design for Manufacture

Concepts of designing for manufacture (DFM) in new product development are studied. Methods of evaluating design efficiencies are discussed and projects assigned to evaluate current designs and methods for improving the design. Boothroyd and Hitachi methods of rating design for assembly are examined. 3 credits. Prerequisite: 23.305 or 23.306 or permission of coordinator.

23.475 Heat Transfer

Studies heat conduction in solids, fluid flow and convective heat transfer, heat exchangers, and heat transmission by radiation. Solutions to problems that arise in practice will be discussed. 3 credits. Prerequisites: 23.241, 23.242, 92.226, 92.263.

23.478 Air-Conditioning System

Presents a short review of thermodynamics and heat transfer, thermodynamic properties of moist air, humidity measurement, psychometric charts, heating and cooling of moist air, solar radiation calculation, heat transmission in buildings, system evaluation and design. 3 credits. Prerequisites: 23.241, 23.475.

23.480 CADES (Computer Aided Design)

Presents a basic approach to design in which the use of wireframe modeling, solid modeling, and finite element analysis are coordinated in such a way as to allow for efficient, and effective product development. Through a series of lectures, hands-on workshops, and accompanying discussions, students will develop experience with, and an appreciation for the potential contribution that various computer-aided tools can make in the overall design process. Projects required. 3 credits. Prerequisites: 23.200, 23.354.

23.481 Applied CAD Design

Involves the application of the student's engineering knowledge, and computer-aided design skill to solve a practical design problem. Students will be involved in semester long, open ended projects that will require project planning, computer aided design execution, presentation of oral and written progress reports, and a final report. Work may be individual or a team effort, depending on the complexity of the project. 3 credits. Prerequisite: 23.480.

23.483 Aerodynamics

Discusses the fundamentals of subsonic aerodynamics. Topics to be covered include: airfoil data including Mach number and Reynolds number effects, circulation, downwash, wing theory, lift and drag, and aircraft performance calculations. 3 credits. Prerequisites: 23.242, 92.226, 92.263.

23.485 Advanced Quality Assurance

Analyzes advanced topics in Statistical Quality Control, including correlation, regression analysis, graphical techniques, goodness-of-fit tests, confidence estimates, analysis-of-variance, design of experiments, and sampling techniques. 3 credits. Prerequisite: 23.416.

Music

71.100 Basic Music Theory

(replaced by 71.110)

71.100A Basic Music Theory

Studies the visual and aural symbolics of music and their application to the comprehension of the architectural, organizational, and aural elements of music literature. Music majors only. 3 credits.

71.102 Music Theory II

Serves as a continuation of the practices of 71.101 relative to part writing (both vocal and instrumental) including secondary triads, the Neapolitan sixth, modal interchange, dominant sevenths in inversion and root position, modulation, and secondary dominants. Instrumentation covers the woodwind section, and original composition in the style being covered is required. 3 credits. Prerequisite: 71.101†. (Offered in summer only)

71.110 Basic Music Theory

(replaces 71.100)

Studies the symbolics of music and their application to the comprehension of the architectural and organizational elements of music literature. Non-music majors only. 3 credits. Area II.

71.203 Visual and Aural Perception of Music III (VAMP III)

Presents an intensive application of requisite skills to chromatic and non-diatonic music, changing and composite meters, displaced accents, cross rhythms, and a vertical approach to reading often necessary in the study of scores. Advanced tonal as well as tonal literature is considered. Harmonic dictation continues to follow the sequence and progress of 71.201. 3 credits. Prerequisite: 71.104†. (Offered in summer only)

74.133 Development of Jazz

Provides an introduction to the concepts of jazz improvisation, rhythm, harmony and style. The course traces the development of jazz from the early New Orleans idiom to the avant-garde and "free" music of the 60's. Emphasis is on major jazz performers and their recorded performance. Open to non-music majors only. 3 credits.

74.161 Music of Western Civilization

A survey of music from earliest times to the present. Significant forms, styles, composers and aesthetic concepts are examined. Open to non-music majors only. 3 credits. Area II.

74.200 American Music

Presents an historical survey of music in the United States from colonial times to the present. Open to non-music majors only. 3 credits.

74.261 Survey of Music History I

Studies sacred and secular musical forms from pre-Christianity to 1750. 3 credits.

74.262 Survey of Music History II

Analyzes musical forms and styles from 1750 to present. 3 credits.

76.210 Opera Workshop

Provides practical experience in the non-performing aspects of operatic and Broadway show production. Open to all students. 3 credits.

Philosophy

45.201 Introduction to Philosophy

Examines some of the typical approaches to philosophical questioning and the issues raised in such inquiry. Questions such as: what is true knowledge, what is reality, what is the good, what is the right political order, what is the nature of religious faith? 3 credits. Area II and Human Values.

45.202 Introduction to Logic

Studies the methods used to distinguish correct from incorrect reasoning. This course will aim at developing (1) an ability to express one's ideas clearly and concisely; (2) an increased skill in defining one's terms; and (3) a capacity to formulate arguments vigorously and to scrutinize them critically. 3 credits. Area II.

45.203 Introduction to Ethics

Examines the basic issues and problems of ethics and values and a survey of some important alternative answers to the questions raised, on both an individual and a social level, by our necessity to act and to live in a rational and human way. 3 credits. Area II and Human Values.

† Offered through the day school. See UMass Lowell's Undergraduate Catalog for course description.

Physics

95.103 General Physics I

Serves as the first semester of a one-year course which surveys the field of physics at a non-calculus level. Topics include force and motion, vectors, gravity, energy and momentum, heat and thermodynamics, and oscillations. Although the course emphasizes conceptual understanding, a functional knowledge of algebra and geometry is essential. 3 credits. Corequisite: 96.103. (Offered in summer only)

95.104 General Physics II

Provides a continuation of 95.103. Topics include waves and sound, electricity and magnetism, geometrical and physical optics, atoms, molecules, and nuclei. 3 credits. Prerequisite: 95.103. Corequisite: 96.104. (Offered in summer only)

95.121 Exploring the Universe

Addresses topics that include: Planet earth, its structure, plate tectonics, greenhouse effect, ozone layer, craters and dinosaurs; our satellite - Moon; other planets; our star - Sun and its energy source; other stars, the HR diagram and stellar evolution, white dwarfs, neutron stars, supernovae, black holes; our galaxy, the Milky Way, its structure; other galaxies; the universe, its structures and expansion; evolution of galaxies, quasars, cosmology, the Big Bang and Unification of the forces of nature. 3 credits. Corequisite: 96.121. Area III.

95.141 Physics I

Serves as the first semester of a sequence for science and engineering majors. Vectors, kinematics in one and two dimensions, dynamics, work and energy, conservation of energy, center of mass, momentum, conservation of momentum, collisions, statics, rotational kinematics, rotational dynamics, angular momentum and periodic motion. 3 credits. Corequisites: 92.131, 96.141. (Offered in summer only)

95.144 Physics II

Focuses on elasticity, fluid mechanics, mechanical waves, acoustics, and thermodynamics, including temperature, heat, and first and second laws. Topics also covered will be optics, including reflection, refraction, geometrical optics, lenses, interference and diffraction. 3 credits. Prerequisite: 95.141. Corequisites: 92.132, 96.144. (Offered in summer only)

95.151 Elements of Physics I

Serves as the first semester of a one-year course which presents an introduction to elementary physics. Topics include motion, forces, equilibrium, work, energy, momentum, circular motion, gravitation and rotational motion. 3 credits. Corequisite: 96.151.

95.152 Elements of Physics II

Provides a continuation of 95.151. Topics include vibrations, waves, sound, electricity and magnetism. 3 credits. Prerequisite: 95.151. Corequisite: 96.152.

95.245 Physics III

Discusses electric charge, Coulomb's law, electric field, Gauss' law, electric potential, capacitance; Ohm's law, Joule effect, electromotive force, Kirchhoff's rules, simple dc-circuits; magnetic field, current loops, Ampere's law, Faraday's law, inductance, electromagnetic waves, ac-circuits, quantum theory; photoelectric effect, deBroglie waves, Bohr atom and quantum mechanics. 3 credits. Prerequisites: 95.144, 92.132. Corequisites: 92.231, 96.245. (Offered in summer only)

96.103 Experimental General Physics I

Presents the first semester of a one-year course which surveys the field of experimental physics with topics correlated to the corequisite lecture course. 1 credit. Corequisite: 95.103 or 95.201†. (Offered in summer only)

96.104 Experimental General Physics II

Serves as a continuation of 96.103 with topics correlated with the corequisite lecture course. 1 credit. Prerequisite: 96.103. Corequisite: 95.104 or 95.202†. (Offered in summer only)

96.121 Exploring the Universe Laboratory

Provides laboratory exercises to illustrate the basic principles and measurement techniques of astronomy. Quantitative techniques, properties of angles, modeling the earth-sun system, comparative planetology, the constellations, the inverse square law, blackbody radiation and spectra, the Hertzsprung-Russell diagram, distances to the stars, the Andromeda galaxy, cosmology. 1 credit. Corequisite: 95.121. Area III.

† Offered through the day school. See UMass Lowell's Undergraduate Catalog for course description.

96.141 Experimental Physics I

Serves as an introductory course on methods and techniques of experimentation in physics with experiments in mechanics selected to support the concepts of the corequisite lecture course. 1 credit. Corequisite: 95.141.

96.144 Experimental Physics II

Serves as a continuation of 96.141 with experiments in waves and oscillations, thermal physics and optics to support the concepts of the corequisite lecture course. 1 credit. Prerequisite: 96.141. Corequisite: 95.144.

96.151 Experimental Elements of Physics I

Provides an introduction to experimentation in physics with experiments in mechanics, waves and oscillations to support the concepts of the corequisite lecture course. 1 credit. Corequisite: 95.151.

96.152 Experimental Elements of Physics II

Presents a continuation of 96.151 with experiments in optics and electricity and magnetism to support the concepts of the corequisite lecture course. 1 credit. Prerequisite: 96.151. Corequisite: 95.152.

96.245 Experimental Physics III

Serves as a further continuation of 96.144 with experiments primarily in electricity and magnetism to support the concepts of the corequisite lecture course. 1 credit. Prerequisite: 96.144. Corequisite: 95.245. (Offered in summer only)

99.101 Radiation and Life

Will provide students with an understanding of the nature, sources, uses, and biological effects of natural and man-made radiations. Radiations discussed include non-ionizing radiations such as ultraviolet and microwave as well as the ionizing radiations produced by radon in homes and radionuclides released from nuclear power plants. Students will have a better understanding of the risks and benefits of radiation in the modern world. 3 credits. Corequisite: 99.102. Area III.

99.102 Radiation and Life Laboratory

Provides the student with an opportunity for some hands-on experience with modern equipment used to identify and quantify levels of radioactivity in the environment. Students will measure radiation from a variety of sources and will determine concentra-

tions of radionuclides in several environmental samples including the radon levels in the air of their own homes. Students will also study the effects of ionizing radiation on the germination and growth rate of exposed seeds. Suitable for non-science majors. 1 credit. Corequisite: 99.101. Area III.

99.121 Science from our Lives

Explores some of our numerous everyday interactions with nature. Both by doing experiments, and learning about experiments done by others, students will change their view of nature and how it affects their lives. The range of topics, primarily from physical science, will include methods in science, motion, energy, properties of materials and other topics of interest to the class. Students will complete a term project as well as readings and other written assignments. 3 credits.

99.131 Technical Physics I

Presents material in both the class and laboratory format. Topics include: vectors; one- and two-dimensional motion; Newton's laws of motion; translational and rotational equilibrium; work and energy; linear momentum; and circular motion and gravitation. Two additional Friday night classes are required. 3 credits. Corequisite: 92.125.

99.132 Technical Physics II

Covers material in both the class and laboratory format. Rotational dynamics; mechanical vibrations and waves; sound; solids and fluids; thermal physics; heat and law of thermodynamics will be discussed. One session per week. Two additional Friday night classes are required. 3 credits. Prerequisite: 99.131. Corequisite: 92.125.

99.133 Technical Physics III

Presents material in both the class and laboratory format. Reflection, refraction, mirrors, lenses, wave optics, optical instruments, Coulomb's law, magnetic force, quantum physics, atomic physics and nuclear physics will each be addressed. One session per week. Two additional Friday night classes are required. 3 credits. Prerequisite: 99.132. Corequisite: 92.126.

Plastics

Note: 27.--- Plastics courses are not eligible for graduate credit.

27.201 Plastics Material Science I (Commodity Thermoplastics)

Serves as an introductory course reviewing the history, classification, definitions and terminology, raw materials, methods of manufacturing, testing-characterization of typical physical properties, and end-uses of polymeric materials systems. Emphasis will be on the commodity thermoplastics, polyolefins, vinyls and styrenics. 3 credits.

27.202 Plastics Material Science II (Engineering Thermoplastics)

Presents a continuation of 27.201, emphasizing engineering thermoplastics, nylons and acetals, acrylics and cellulose, polycarbonates, polysulfones, modified PPE, polyesters, fluoropolymers, polyimides, PPS, PEI and LCP's, copolymers, alloys and blends. Discussions will review the chemistry, properties, processability and design limitations of these high performance engineering and specialty polymers. 3 credits. Prerequisite: 27.201.

27.203 Plastics Material Science III (Thermosetting Resins)

Provides an in-depth review of the major families of thermosetting resins: phenolics, amines, polyesters, epoxies, silicones, and various polyurethane systems. Emphasis is on basic chemistry, inherent physical properties and processability, and the effect of incorporating fillers, reinforcements, colorants, lubricants, and other chemical additives in order to "engineer-in" necessary processing ease, and to meet functional performance end-use demands. 3 credits. Prerequisite: 27.202.

27.217 Plastics Processing Engineering Laboratory

Focuses on polymer processing methods. Experiments are designed so that the student will understand the theory of polymer conversion techniques by the interaction between process variables and materials. Some of the conversion methods studied are extrusion, injection molding, blow molding, thermoforming, compounding and mixing. 1 credit.

27.301 Additives for Polymeric Materials

Presents an analysis of additives including stabilizers, plasticizers, fillers and reinforcements, biocides,

flame retardants, antistatic agents, and release agents. Special emphasis will be placed on the characteristics of each type of additive, compatibility interactions and effects on processing. A review of the most current methods of testing efficiency of each additive system will also be covered. 3 credits.

27.303 Reinforced Plastics and Composites

Reviews composites as a class of materials and the mechanical physical characteristics. Topics include fundamental concepts underlying these properties, with particular emphasis on fibrous reinforced plastics. A survey of matrices, reinforcements and methods of fabrication will also be conducted. 3 credits. Prerequisite: 27.203.

27.373 Plastics Mold Engineering I

Explores material in both the class and laboratory format. Topics include an introduction to the principles of basic mold and die design and construction, and laboratory design of molds and/or dies to be constructed in continuing portions of this course. Lecture, laboratory and demonstrations will be offered at the discretion of the instructor. 3 credits.

27.376 Plastics Mold Engineering II

Serves as a continuation of 27.373. 3 credits.

27.401 Processing Technology I

Presents material in both the class and laboratory format. Theory and methods of processing plastics materials including compounding, molding, extruding and thermoforming will be covered. Evaluation and development of typical problems will also be discussed. Laboratory sessions and demonstrations will be scheduled by the instructor. 3 credits. Prerequisite: 27.202.

27.402 Processing Technology II

Presents material in both the class and laboratory format, serving as a continuation of 27.401. Discusses casting, laminating, fabricating and finishing, processing and fabricating with product design and applications. Laboratory sessions and demonstrations will be scheduled by the instructor. 3 credits. Prerequisite: 27.401.

27.403 Physical Properties of Polymers I

Introduces basic mechanical properties of polymers as linear viscoelastic materials. The concepts of creep, stress relaxation and superposition principles are emphasized. Dynamic mechanical behavior, interrelations between various properties, electrical

behavior, miscellaneous mechanical properties and optical properties will also be covered. 3 credits. Prerequisites: 84.223, 84.225, 84.344 and 86.355.

27.404 Physical Properties of Polymers II

Serves as a continuation of 27.403. 3 credits.

27.405 Polymer Characterization

Discusses instrumental methods of characterizing plastics materials. The theory and interpretation of infrared spectroscopy, gas chromatography, gel permeation chromatography, differential thermal analysis, thermal gravimetric analysis, etc. are covered. The determinations will include elucidation of structure, identification, molecular weight, molecular weight distribution and glass transition temperatures. 3 credits. Prerequisite: permission of coordinator.

27.406 Polymer Structures

Presents the fundamental relationship between molecular structure, properties and end-use applications of plastics materials. Molecular structural features include chemical composition, molecular size and flexibility, intermolecular order and bonding, and supermolecular structure. Properties to be covered include processability, mechanical, acoustic, thermal, electrical, optical and chemical properties, price, and balance of properties. Applications to be discussed include rigid solids, flexible solids, foams, film and non-plastic applications. 3 credits. Prerequisite: permission of coordinator.

27.407 Plastics Industry Organization

Discusses the economics of producing plastic's raw materials and converting them into end products, from research and development to plant construction, operation and marketing. Market analysis of plastics production, processing, and consumer patterns: commercial development, sales, and technical service will be addressed. Organization of the plastics industry for research and development, specialty and commodity production, profit and growth will also be presented. 3 credits. Prerequisite: permission of coordinator.

27.408 Adhesives and Adhesions

Addresses adhesive joining of engineering materials. Surface chemistry, theories of adhesion and cohesion, joint design, surface preparation, commercial adhesives, rheology, equipment, testing, service life and reliability. 3 credits. Prerequisites: 84.223, 84.225, 84.344 and 86.355.

27.409 Coatings Science and Technology I

Examines polymers, pigments, solvents and additives used in coatings. Methods of polymerization, formulation, application and testing are discussed. Substrates and applications will also be covered. 3 credits. Prerequisites: 84.223 and 84.225.

27.410 Coatings Science and Technology II

Serves as a continuation of 27.409. 3 credits.

27.411 Rheology of Coatings

Studies rheology of polymer melts, solutions, latexes and pigment dispersions, and their application to coatings and adhesives. 3 credits. Prerequisites: 84.344 and 86.355.

27.418 Product Design

Discusses the theoretical principles and sound engineering practices involved in the design of new end products made from polymers, applying the total systems approach to the balance between product design, choice of materials, tool design, and process techniques, as they affect competitive choices for commercial success. A semester project is required. 3 credits. Prerequisite: permission of coordinator.

27.425 Dynamic Mechanical Properties of Plastics I

Focuses on the principles, experimental techniques, and investigative strategies for characterizing the viscoelastic behavior of polymers using dynamic mechanical techniques. Lectures and demonstrations will review the methodology for identifying the important rheological characteristics of polymeric solution, melts, and solids. Comparisons with other, more traditional practices will be established for quality of data, sensitivity of macromolecular architecture, and components of materials engineering. 3 credits. Prerequisite: permission of coordinator.

27.426 Dynamic Mechanical Properties of Plastics II

Serves as a continuation of the 27.425 introductory course. 3 credits. Prerequisite: 27.425.

27.440 Commercial Development of Polymeric Material Systems

Reviews the concepts of industrial marketing for research, pricing strategies, and product planning for market segmentation, place (distribution), promotional activities. Topics include creating a demand, selling, and servicing base resins and additives. 3 credits. Prerequisite: permission of coordinator.

27.451 - 27.458 Selected Topics I - VIII

Addresses specialized topics in applied polymer science, adhesives, elastomers, coatings and fibers as well as other timely subjects. 3 credits. Prerequisite: permission of coordinator.

Political Science

46.101 Introduction to American Politics

Provides an introductory analysis of structures, functions and behavior of the American political community. The analysis emphasizes politics and political behavior at the national level. 3 credits. Area I.

46.110 Introduction to Politics

Serves as an introductory exploration of basic political concepts, ideas and themes. 3 credits. Area I.

46.121 Introduction to International Relations

Surveys some recent methods and approaches used in the study of international politics and provides an introduction to current problems of foreign policies of major world powers. 3 credits. Area I.

46.230 Law and the Legal System

Presents an introduction to the nature of the legal process and the operation of the American legal system. Considerations of its political and social functions will also be discussed. 3 credits.

46.240 Contemporary Political Theory

Examines major ideological currents in the contemporary world. Topics include communism, fascism, anarchism, socialism, nationalism, liberalism and utilitarianism. 3 credits. Area I and Human Values.

46.353 Public Administration and Public Policy

Examines public policy formation within bureaucratic frameworks. 3 credits.

46.357 Environmental Policy

Addresses American environmental values and politics; attitudes and behavior towards the environment. Special attention to current issues. 3 credits. Area I.

46.368 Middle East in the Modern World

Utilizes an appreciation of Middle Eastern attitudes and values in developing insight into the tensions within the Middle East and between the Middle East and the western world. 3 credits. Area I.

Psychology

47.101 General Psychology

Intended as an introductory course both for non-concentrators and for concentrators; this course surveys the major areas of psychology: the nature of psychology as a science, principles of learning, the relationship between physiological and psychological processes in humans and animals, sensation and perception, cognitive processes, motivation and emotion, personality and development, adjustment and behavior disorders, and social behavior. 3 credits. Area I.

47.209 Social Psychology

Presents an introduction to the study of social behavior in interpersonal relationships, groups, organizations and the community. Topics include attitudes and attitude change, group dynamics, leadership and interpersonal influences. 3 credits. Area I and Human Values.

47.232 Psychology of Personality

Serves as an introduction to the study of human personality including such topics as self-concept, anxiety and adjustment, and achievement motivation. Psychoanalytic, humanistic, cognitive, and behavioral theories of personality are stressed with consideration of the interplay between theory and research. 3 credits. Area I.

47.255 Community Psychology

Surveys the nature and practice of community psychology, including principles of community organization and change as seen in such areas as education, mental health, corrections and social services. Students will participate in field research or practice under the direction of an assigned agency, and classroom work will include discussion of the field experiences of the participants. 3 credits. Area I.

47.260 Human Development I

Begins with an overview of major theoretical perspectives, research methods and ethical issues in lifespan human development. Based on a chronological approach, the course covers prenatal development and birth, infancy, childhood and adolescence, and the transition to adulthood. 3 credits. Area I.

47.269 Research Methods

Provides an integrated approach to methods of scientific research in psychology including research design and the use of statistics, the interpretation of data, and the role of the scientific method in psychology. Open to Psychology majors only. 3 credits.

47.272 Abnormal Psychology

Presents an introduction to the study of various patterns of neurotic, psychotic and character disorders. Therapeutic techniques and other auxiliary methods for the treatment of such disorders are studied in relation to contemporary theory and research. 3 credits. Prerequisite: 47.101. Area I.

47.276 Theories of Learning

Traces the development of theories of learning from earlier global theories to more recent and more specific ones. Behavioral, cognitive and physiological approaches will be compared. Current issues of importance in the study of learning will also be stressed. 3 credits. Prerequisite: 47.101. Area I.

47.277 Sensation and Perception

Focuses on human sensory and perceptual capacities, and how people know the objects and events of the world through hearing, seeing, smelling, tasting, moving, and touching. In this course, students examine the bases of experiences which correspond to independent measures of the world and the nature of illusory experiences. 3 credits. Prerequisite: 47.101. Area I.

47.312 Learning and Behavior

Examines various methods and techniques suitable for the modification of human behavior, based on the principles and findings of experimental studies of animal and human behavior. Considers how such methods can be used in education, mental health and corrections, and self-directed personal change. 3 credits. Prerequisite: 47.101.

47.328 Dynamics of Interpersonal Relations

Presents an analysis of psychological dynamics in interpersonal behavior, emphasizing such topics as conformity, leadership, interpersonal growth, self-disclosure, personal styles of interaction and technique of change. The primary focus will be on the behavior of the students themselves, who form a small group in which they are expected to participate. The course is taught without a formal prerequisite, but students should have some previous course work in psychology. 3 credits. Area I.

47.335 Psychology of Women

Considers such topics as: the psychology of sex differences; biological bases of psychological sex differences; the nature of female sexuality; clinical theory and practice concerning women; women as mental patients and mental health consumers; implications for psychology and for women's status. Taught without prerequisite but intended primarily for juniors and seniors. 3 credits. Area I and Human Values.

47.352 Psychological Testing

Surveys major tests and techniques used to assess cognitive abilities, personality and vocational interests; an introduction to the various professional settings in which testing and assessment methods are used (e.g., mental health, rehabilitation, employment and personnel selection, criminal justice). Students learn to administer, score, and interpret specific tests and learn how to develop a case study or report based on test data and related information. 3 credits. Prerequisite: 47.101.

47.360 Human Development II

Begins with an overview of recent theoretical perspectives on adult development and aging. It presents, in chronological sequence, the stages of adulthood and concludes with death and dying. Topics covered include personal, family and vocational development through adulthood; gender pattern differences; and the impact of changing demographics, including the lengthening of the life span. 3 credits. Prerequisite: 47.260.

47.361 Problems and Issues in Childhood and Adolescence

Examines specific disorders occurring during childhood and adolescence, including neurotic disorders, autism and psychoses, retardation and learning disabilities, and conduct disorders. Consideration will also be given to developing an understanding of how parent/child interactions may impair healthy development (e.g. child abuse, neglect, parental alcohol and substance abuse). 3 credits. Prerequisites: 47.101, 47.260.

47.362 Human Development: Theories, Ethics and Research Strategies

Examines some of the major theories, research methodologies and ethical considerations in the study of human development. Utilizing a life span approach and building on the introductory course in life span developmental psychology, this course focuses upon an analysis of major theoretical perspectives and relevant research. 3 credits. Prerequisite: 47.260.

47.364 Psychology of Crime and Corrections

Investigates the psychological aspects of crime and deviance, and the nature of punishment and rehabilitation. Clinical case histories or criminal personalities will be combined with experimental studies of anti-social and violent behavior. The nature of prisons and criminal justice will be examined. 3 credits. Prerequisite: 47.272. Area I.

47.369 Statistics in Psychology

Provides an introduction to basic statistics used in psychology including descriptive statistics, sampling, the normal distribution, correlation and regression, and inferential statistics (t test, chi-square, analysis of variance). 3 credits. Prerequisite: 47.269 or permission of instructor.

47.373 The Biology of Behavior

Surveys issues and topics dealing with the physiological and evolutionary bases of behavior. Biological systems and processes that influence behavior are considered, with particular emphasis on brain mechanisms. Recent discoveries in the neurosciences will be presented. Methods of research are reviewed. 3 credits. Prerequisite: 47.101.

47.473 Seminar in Social Psychology

Presents an intensive study of one or more of the following special topics in social psychology: psychology of the family and parent-child relations; oral development; adjustment during adulthood; death and dying; etc. 3 credits. Prerequisites: 47.101 and permission of instructor.

47.474 Seminar in Developmental Psychology

Presents a careful consideration of selected topics in the area of human development, including the following: psychology of the family and parent-child relations; infant development; adjustment during adulthood; and death and dying, etc. 3 credits. Prerequisite: 47.101 and permission of instructor.

47.475 Seminar in Clinical Psychology

Focuses on such topics as: the nature of psychotherapy and clinical practice; analysis of specific clinical theories of psychopathology and psychotherapy (transactional analysis, Gestalt, psychoanalysis); the nature and causes of specific psychological disorders (schizophrenia, affective disorders, etc.); the nature of mental hospitals; the community mental health

movement; clinical methods of assessment; and current topics in personality theory and research, etc. 3 credits. Prerequisite: 47.232 or 47.272 or permission of instructor.

47.477 Seminar: Contemporary Trends in Psychology

Surveys issues in contemporary areas of psychological practice and/or research; implications for future developments in the field will be covered. 3 credits. Prerequisite: 47.101. Other prerequisites may be specified by the instructor.

Sociology

48.101 Introduction to Sociology

Serves as the basic course in sociology. Emphasis is directed at the ways in which social institutions such as government, schools, the economy, social class and the family develop and influence our lives. It is concerned not only with presenting various ways to understand our relationship to society, but also with ways to change it. 3 credits. Area I.

48.201 Social Anthropology

Examines several distinct cultures as a means of understanding both the universal constants and the variations in human societies, using the comparative approach to society. 3 credits. Area I and Human Values.

48.220 Self Assessment and Career Development

Studies the meaning of work in our society. Class participants will assess their own life experiences and develop plans to integrate interests, values and abilities into meaningful and realistic life/work options. 3 credits.

48.231 Sociology of the Family

Studies the nature of the family in contemporary society, with particular emphasis on the family in America. What functions does the family perform in modern society? How is it changing? How do these changes affect our lives? 3 credits. Area I.

48.241 Women in Society

Discusses how the women's movement has changed our accepted views of women and men. This course will seek an understanding of the positions of women and men in culture, the economy, the family and

political life. Crucial are the questions: "What do we want?" and "What do we need?" Specific topics will be examined. 3 credits. Area I and Human Values.

48.250 Sociology of Non-Violence

An analysis of nonviolent efforts to achieve social change through demonstrations, civil disobedience, etc. Movements led by Mahatma Gandhi, Martin Luther King, Jr., and others are examined. 3 credits.

48.255 Social Deviance

Presents an analysis of behavior considered deviant, such as drug abuse, crime and mental disorders. Attention is paid to cultural definitions of deviance and to social institutions that treat people defined as deviant. 3 credits.

48.256 Political Sociology

Focuses on the development and use of power in modern society. Emphasis is placed on the relationship of American political institutions to economic institutions, to social class, and to supporting ideologies. 3 credits.

48.260 Sociology of Mass Media

Investigates the structure of mass communications and the impact of the media on our lives. A full range of media are considered, including television, radio, cinema and the press. The potential impact of new media sources such as cable TV are also considered. 3 credits. Area I and Human Values.

48.301 Sociology of Human Rights

Examines the politically divergent definitions of rights and freedoms. Attention will be paid to the activities of international human rights organizations to the human rights policies of the major powers. Various current human rights issues will be examined. Case histories may include the Soviet Union, Northern Ireland, South Africa, Afro-Americans, Armenians and Palestinians. 3 credits. Prerequisite: 48.101.

48.305 Sociology of Family Law

Examines some social issues in family law, the changes therein and the social climate and consequences accompanying these. By using the sociological method of inquiry to examine family law cases, the relationship between law and society as instruments of order and change are exemplified. 3 credits. Prerequisite: 48.101.

48.309 Military and Society

Focuses on the role of war and the development of military technology in modern societies; how the armed forces interact with civilian economy and society. 3 credits. Prerequisite: 48.101.

48.314 Nuclear Weapons, Values and Society

Examines popular values and conceptions concerning nuclear weapons, and of the political, diplomatic and economic issues surrounding these weapons. A detailed consideration of the strategic and political interests of the major powers; of current political and economic changes in Europe and Soviet Union; and of nuclear weapons proliferation in developing countries; a discussion of alternatives to the nuclear arms race such as global security or non-provocative defense. 3 credits. Area I and Human Values.

48.323 The Sociology of Ideas and Values

Considers the ways in which ideas and values arise in society and in turn influence social action. Included are scientific facts, myths, ideologies, religions, morals, and common sense beliefs. 3 credits. Prerequisite: 48.101.

48.335 The Black Experience in American Life

Focuses on the careful examination of the role and status of Blacks in the United States since slavery. Prejudice, racism, and black separatism are emphasized. 3 credits. Prerequisite: 48.101.

48.340 Sociology of Sports

Examines the history of modern sport at the amateur and professional level and international competition. The impact of race, sex, economics and politics on the institution of sports will also be examined. 3 credits. Prerequisite: 48.101.

48.351 The Sociology of Health and Health Care

Presents a historical and contemporary study of the socio-politics of health, illness, and the health care industry in the United States. Attention is given to providers, consumers, owners, workers, and professionals in terms of their power, class, race, sex, and age. Reforms and alternatives are considered. 3 credits. Prerequisite: 48.101.

48.361 Sociology of Law and the Criminal Justice System

Presents an introduction to the theory, structure, ideology and practice of the criminal justice system. Particular attention is directed at the definition of crime and the impact of social, political and economics policy on the operation of systems and their impact on its "clients". 3 credits. Prerequisite: 48.101. Area I.

48.382 Social Movements

Considers organized action undertaken to alter the social position of a group. Organization, techniques of action, motivation of participants, and group ideologies are studied. Materials from historical, social, psychological, and sociological sources are used. 3 credits. Prerequisite: 48.101. Area I and Human Values.

Technical Writing

42.401 Principles of Technical Writing

Provides the fundamental concepts and principles of technical writing, including technical description, audience analysis, editing, document specifications and outlines, graphics, definitions, and revising documents. Writing assignments include preparing a document specification, editing and creating graphics. 3 credits.

42.402 Software Writing

Focuses on the document preparation process from start to finish, focusing on each stage in the process. Includes document design, document organization, using examples and illustrations, style, creating an index and the review process. 3 credits.

42.403 Advanced Software Writing

Introduces a range of advanced topics in software writing. Topics may include electronic publishing, hypertext, advanced graphics, document set components and working in project teams. In this course, the student selects some aspect of the computer industry that interests him/her and documents it. 3 credits.

42.404 Marketing Writing

Teaches the student how to write promotional materials such as brochures, press releases, data sheets and new product announcements. The student also learns how to give demonstrations and use

interviews to gather information. This course focuses on understanding computer culture with on-site visits and guest lectures. Assignments include preparation of a brochure and other promotional materials. 3 credits.

Degree and Certificate Requirements

This section of the catalog provides the programs of study required to complete degree and certificate requirements in three colleges: the College of Arts and Sciences, the College of Engineering, and the College of Management.

All of the academic majors and options are listed in alphabetical order within each College. Each curriculum outline consists of a suggested course of study listing three courses in the fall and spring semesters. Students may vary from this suggested sequence by taking fewer or more courses each semester, or by taking courses during the summer sessions and winter intersessions. Although students have some flexibility in scheduling courses, they should adhere to appropriate prerequisite requirements.

Associate and Baccalaureate Degree Programs

The Division of Continuing Education offers a number of degree programs through the individual colleges at UMass Lowell. Students enroll in these programs to obtain practical knowledge and skills, to sharpen skills for professional advancement, to facilitate a career change, and to gain personal enrichment and satisfaction.

These associate and baccalaureate degrees can be completed part-time, during the evening. Degree candidates must officially apply for admission.

Since undertaking a degree program requires careful planning and scheduling of classes, students are encouraged to meet with an academic advisor prior to registering for courses. Academic advisors can help students select courses, plan a program of study, and evaluate transcripts of previous academic work. To arrange an appointment with an advisor, call the Office of Enrollment Services at (508) 934-2480.

Certificate Programs

Certificate programs provide an opportunity for students to obtain marketable skills within a concentrated time frame. Designed for those who want specialized skill sets, but do not want to pursue a degree program at this time, the certificate programs consist of five to eight credit-courses that demonstrate expertise in a specific area. The certificate programs have been developed through extensive research and the curricula are reviewed and approved by an advisory board of experts. Each program requires approximately one year to complete. In most cases, certificate program courses may be applied to a related degree program. Not more than one course from another institution may be used to satisfy requirements of a certificate program.

College of Arts and Sciences

The College of Arts and Sciences offers the following Continuing Education undergraduate programs:

Associate's and Bachelor's Degrees:

Applied Chemistry, A.S., B.S.	78-79
Coatings Option, B.S.	79
Biotechnology Option, A.S.	80
Hazardous Waste Option, A.S.	80
Applied Mathematics, A.S., B.S.	81-82
Computer Mathematics Option, A.S., B.S.	83-84
Information Systems, A.S., B.S.	85
Criminal Justice, A.S., B.S.	86-89
Paralegal Option, B.S.	89-90
Bachelor of Liberal Arts, B.L.A.	91
(Concentrations in History, Political Science, Psychology, Sociology)	

Certificate Programs:

Computer Proficiency	92
Data/Telecommunications	92
Paralegal Studies	93
Security Management	93
Technical Writing	94
UNIX	94

Associate of Science in Applied Chemistry

Years 1 - 4: Suggested Course of Study

Total Credits: 64

This course outline which lists 3 courses each semester is only a suggested course load. First year students should not take more than 1 or 2 courses their first semester. Subsequent course loads may be determined by the students' own personal time constraints.

First Semester

Second Semester

No.	Title	Credits	No.	Title	Credits
First Year					
84.121	Chemistry I	3	84.122	Chemistry II	3
92.121	Precalculus Mathematics	3	92.115	College Trigonometry	3
42.101	College Writing I	<u>3</u>	42.102	College Writing II	<u>3</u>
		9			9
Second Year					
86.121	Analytical Chemistry A	3	86.122	Analytical Chemistry B	3
92.125	Calculus A	3	92.126	Calculus B	3
99.131	Technical Physics I	<u>3</u>	99.132	Technical Physics II	<u>3</u>
		9			9
Third Year					
84.223	Principles of Organic Chemistry I	3	84.224	Principles of Organic Chemistry II	3
84.225	Principles of Organic Chemistry Lab I	1	84.226	Principles of Organic Chemistry Lab II	1
15.340	Hazardous Waste Management	<u>3</u>	99.133	Technical Physics III	<u>3</u>
		7			7
Fourth Year					
84.344	Physical Chemistry I	3	84.345	Physical Chemistry II	3
86.355	Experimental Physical Chemistry	1	84.347	Physical Chemistry Laboratory II	1
-----	Elective	<u>3</u>	-----	Elective	<u>3</u>
		7			7

Bachelor of Science in Applied Chemistry

Years 5-8: Suggested Course of Study

Total Credits: 135

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
Fifth Year					
84.334	Advanced Inorganic Chemistry	3	86.352	Chemical Applications	3
92.386	Statistics for Science and Engineering	3	--- --	Computer Elective*	3
42.226	Technical and Scientific Communication	<u>3</u>	--- --	Area II Elective	<u>3</u>
		9			9
Sixth Year					
86.361	Advanced Organic Chemistry I	3	86.362	Advanced Organic Chemistry II	3
27.201	Plastics Material Science I	3	23.295	Materials Science	3
--- --	Area II Elective	<u>3</u>	--- --	Elective	<u>3</u>
		9			9
Seventh Year					
86.471	Industrial Chemistry	3	84.314	Analytical Chemistry II	3
49.201	Economics I (Microeconomics)	3	84.316	Analytical Chemistry Lab II	2
--- --	Area I or II Elective	<u>3</u>	49.202	Economics II (Macroeconomics)	<u>3</u>
		9			8
Eighth Year					
86.481	Chemistry of High Polymers I	3	86.482	Chemistry of High Polymers II	3
--- --	Elective	3	--- --	Human Values Elective	3
--- --	Elective	<u>3</u>	--- --	Elective	<u>3</u>
		9			9

* An introductory computer course in a programming language other than COBOL.

Bachelor of Science in Applied Chemistry: Coatings Option

The requirements for this program are those of the Bachelor of Science Program in Applied Chemistry with five of the elective courses being selected from the list below and other relevant courses approved by the program coordinator.

No.	Title	Credits	No.	Title	Credits
27.403	Physical Properties of Polymers I	3	27.411	Rheology of Coatings	3
27.408	Adhesives and Adhesions	3	27.453	Colloids	3
27.409	Coatings Science and Technology I	3	27.457	Plastics Coatings in Electronics	3
27.410	Coatings Science and Technology II	3			

Associate of Science in Applied Chemistry: Biotechnology Option

Years 1-4: Suggested Course of Study

Total Credits: 64

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
First Year					
84.121	Chemistry I	3	84.122	Chemistry II	3
92.121	Precalculus Mathematics	3	92.115	College Trigonometry	3
42.101	College Writing I	<u>3</u>	42.102	College Writing II	<u>3</u>
		9			9
Second Year					
86.121	Analytical Chemistry A	3	86.122	Analytical Chemistry B	3
92.125	Calculus A	3	92.126	Calculus B	3
99.131	Technical Physics I	<u>3</u>	99.132	Technical Physics II	<u>3</u>
		9			9
Third Year					
84.223	Principles of Organic Chemistry I	3	84.224	Principles of Organic Chemistry II	3
84.225	Principles of Organic Chemistry Lab I	1	84.226	Principles of Organic Chemistry Lab II	1
86.341	Intro. to Biotechnology	<u>3</u>	86.343	Biotechnology Lab I	<u>2</u>
		7			6
Fourth Year					
84.344	Physical Chemistry I	3	84.345	Physical Chemistry II	3
86.355	Experimental Physical Chemistry	3	84.347	Physical Chemistry Lab II	1
86.342	Principles of Biotechnology II	<u>3</u>	86.344	Biotechnology Lab II	<u>2</u>
		9			6

Associate of Science in Applied Chemistry: Hazardous Waste Option

Years 1-4: Suggested Course of Study

Total Credits: 64

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
First Year					
84.121	Chemistry I	3	84.122	Chemistry II	3
92.121	Precalculus Mathematics	3	92.115	College Trigonometry	3
42.101	College Writing I	<u>3</u>	42.102	College Writing II	<u>3</u>
		9			9
Second Year					
86.121	Analytical Chemistry A	3	86.122	Analytical Chemistry B	3
92.125	Calculus A	3	92.126	Calculus B	3
99.131	Technical Physics I	<u>3</u>	99.132	Technical Physics II	<u>3</u>
		9			9
Third Year					
84.223	Principles of Organic Chemistry I	3	84.224	Principles of Organic Chemistry II	3
84.225	Principles of Organic Chemistry Lab I	1	84.226	Principles of Organic Chemistry Lab II	1
15.340	Hazardous Waste Management	<u>3</u>	99.133	Technical Physics III	<u>3</u>
		7			7
Fourth Year					
84.344	Physical Chemistry I	3	84.345	Physical Chemistry II	3
86.355	Experimental Physical Chemistry	1	84.347	Physical Chemistry Lab II	1
23.310	Industrial Safety	<u>3</u>	84.352	Chemical Safety	<u>3</u>
		7			7

Applied Mathematics

Mathematics has always been essential to our intellectual and technological advancement, and in the coming decades our reliance on the mathematical sciences will become increasingly universal. As the twenty-first century rapidly approaches, one's mastery of the tools and techniques that are covered by the mathematical sciences will define his/her success. The major in Applied Mathematics is designed to provide a sequence of courses which will acquaint the student with important concepts underlying the main branches of mathematics. The Applied Mathematics and Information Systems majors are offered under requirements of the College of Arts and Sciences for both the Associate and Bachelor of Science degrees.

The Mathematical Sciences department of the University offers three programs through Continuing Education: Applied Mathematics, Applied Mathematics: Computer Mathematics Option and Information Systems. The Applied Mathematics and the Applied Mathematics: Computer Mathematics Option curricula are intended for working professionals in a wide range of related disciplines: science, engineering, decision analysis, operation research, mathematical biology, economics, computer science, etc. Students interested in the Applied Mathematics major are encouraged to take advantage of its flexibility by taking a sequence of courses related to the mathematical application of their choice. Nine courses (technical and computer electives) allow the student and advisor to tailor programs to individual objectives and talents. The Applied Mathematics: Computer Mathematics Option program allows students to take advantage of the many state-of-the-art computer courses available through Continuing Education.

The major in Information Systems is a less mathematical curriculum. Students have the opportunity to learn the skills necessary to manage the stream of information particular to their area of interest using the ever-changing computer technology essential for success as we approach the twenty-first century. Many students come to the University to receive a certificate in UNIX, Computer Proficiency or Data/Telecommunications. They can then pursue a degree in Information Systems by applying the courses taken to fulfill the certificate program requirements.

Associate of Science in Applied Mathematics

Years 1-4: Suggested Course of Study

Total Credits: 72

The following course outline which lists 3 courses each semester is only a suggested course load. First year students should not take more than 1 or 2 courses their first semester. Subsequent course loads may be determined by the students' own personal time constraints.

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
First Year					
92.121	Precalculus Mathematics	3	92.115	College Trigonometry	3
49.201	Economics I (Microeconomics)	3	49.202	Economics II (Macroeconomics)	3
42.101	College Writing I	3	42.102	College Writing II	3
		9			9
Second Year					
92.125	Calculus A	3	92.126	Calculus B	3
42.226	Technical and Scientific Communication	3	--- --	Area I or II Elective	3
99.131	Technical Physics I	3	99.132	Technical Physics II	3
		9			9

(continues...)

Third Year			
92.225	Calculus C	3	
92.386	Statistics for Science and Engineering	3	
---	Area II Elective	<u>3</u>	
		9	
Fourth Year			
92.221	Linear Algebra I	3	
92.265	Pascal Programming	3	
	(or 92.211 Intro. to Prog. with C)		
84.121	Chemistry I	<u>3</u>	
		9	
92.226	Calculus D	3	
92.321	Discrete Structures I	3	
---	Human Values Elective	<u>3</u>	
		9	
92.222	Linear Algebra II	3	
---	Computer Elective	3	
(92.364	Problem Solving with C is strongly recommended as sequel to 92.211)		
84.122	Chemistry II	<u>3</u>	
		9	

Bachelor of Science in Applied Mathematics

Years 5-8: Suggested Course of Study

Total Credits: 135

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
Fifth Year					
92.234	Differential Equations	3	---	Mathematics Elective	3
92.360	Intro. to Data Structures	3	---	Area II Elective	3
---	Technical Elective	<u>3</u>	---	Computer Elective	<u>3</u>
		9			9
Sixth Year					
92.362	Numerical Analysis I	3	92.454	Numerical Analysis II	3
92.301	Introduction to Applied Mathematics I	3	92.302	Introduction to Applied Mathematics II	3
---	Computer Elective *	<u>3</u>	---	Computer Elective *	<u>3</u>
		9			9
Seventh Year					
---	Mathematics Elective	3	---	Mathematics Elective	3
---	Computer Elective *	3	---	Computer Elective *	3
---	Technical Elective	<u>3</u>	---	Technical Elective	<u>3</u>
		9			9
Eighth Year					
92.411	Complex Variables I	3			
---	Computer Elective*	3			
---	Technical Elective	<u>3</u>			
		9			

*The above courses may be replaced by a sequence of related courses approved by the Program Coordinator.

All electives must be approved by the Program Coordinator.

Many 500-level mathematics courses are within the grasp of upper level undergraduate students. Refer to the day school schedule of classes for graduate course listings. Many graduate courses are offered in the late afternoon/early evening time frame.

Associate of Science in Applied Mathematics: Computer Mathematics Option

Years 1-4: Suggested Course of Study

Total Credits: 72

This course outline which lists 3 courses each semester is only a suggested course load. First year students should not take more than 1 or 2 courses their first semester. Subsequent course loads may be determined by the students' own personal time constraints.

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
First Year					
92.202	Microcomputers and Applications Software	3	92.263	FORTTRAN Programming	3
92.121	Precalculus Mathematics	3	92.115	College Trigonometry	3
42.101	College Writing I	<u>3</u>	42.102	College Writing II	<u>3</u>
		9			9
Second Year					
92.125	Calculus A	3	92.126	Calculus B	3
92.265	Pascal Programming	3	--- --	Computer Elective	3
(or 92.211 Intro. to Prog. with C)			(92.364	Problem Solving with C is strongly recommended as a sequel to 92.211)	
49.201	Economics I (Microeconomics)	<u>3</u>	49.202	Economics II (Macroeconomics)	<u>3</u>
		9			9
Third Year					
92.463	Systems Design and Development I	3	92.464	Systems Design and Development II	3
92.225	Calculus C	3	92.226	Calculus D	3
92.386	Statistics for Science and Engineering	<u>3</u>	99.131	Technical Physics I	<u>3</u>
		9			9
Fourth Year					
92.321	Discrete Structures I	3	92.360	Introduction to Data Structures	3
99.132	Technical Physics II	3	42.226	Technical and Scientific Communications	3
--- --	Computer Elective	<u>3</u>	--- --	Area I or II Elective	<u>3</u>
		9			9

Bachelor of Science in Applied Mathematics: Computer Mathematics Option

Years 5-8: Suggested Course of Study

Total Credits: 135

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
Fifth Year					
92.234	Differential Equations	3	92.455	Assembly Language Programming I	3
92.221	Linear Algebra I	3	92.222	Linear Algebra II	3
-.---	Area I Elective	<u>3</u>	-.---	Area II Elective	<u>3</u>
		9			9
Sixth Year					
92.362	Numerical Analysis I	3	92.454	Numerical Analysis II	3
92.301	Introduction to Applied Mathematics I	3	92.302	Introduction to Applied Mathematics II	3
84.121	Chemistry I *	<u>3</u>	84.122	Chemistry II *	<u>3</u>
		9			9
Seventh Year					
92.462	Systems Programming	3	-.---	Mathematics Elective	3
-.---	Computer Elective	3	-.---	Computer Elective	3
-.---	Technical Elective	<u>3</u>	-.---	Human Values Elective	<u>3</u>
		9			9
Eighth Year					
92.411	Complex Variables I	3			
-.---	Computer Elective	3			
-.---	Technical Elective	<u>3</u>			
		9			

*The above courses may be replaced by a sequence of related courses approved by the Program Coordinator.

All electives must be approved by the Program Coordinator.

Many 500-level mathematics courses are within the grasp of upper level undergraduate students. Refer to the day school schedule of classes for graduate course listings. Many graduate courses are offered in the late afternoon/early evening time frame.

Associate of Science in Information Systems

Years 1-4: Suggested Course of Study

Total Credits: 72

This outline which lists 3 courses each semester is only a suggested course load. First year students should not take more than 1 or 2 courses their first semester. Subsequent course loads may be determined by the students' personal time constraints.

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
First Year					
90.160	Introduction to Information Systems	3	92.202	Microcomputers and Applications Software	3
42.101	College Writing I	3	42.102	College Writing II	3
90.112	Concepts in Algebra I	<u>3</u>	90.119	Concepts in Algebra II	<u>3</u>
		9			9
Second Year					
67.101	Accounting Principles I	3	67.102	Accounting Principles II	3
42.224	Business Writing	3	69.253	Intro to Mgmt. & Org. Behavior	3
92.265	Pascal Programming	<u>3</u>	92.—	Computer Math/Info Systems Elective	<u>3</u>
		9			9
Third Year					
92.—	Computer Math/Info Systems Elective	3	92.—	Computer Math/Info Systems Elective	3
49.201	Economics I (Microeconomics)	3	49.202	Economics II (Macroeconomics)	3
—, —, —	Concentration Elective	<u>3</u>	—, —, —	Concentration Elective	<u>3</u>
		9			9
Fourth Year					
92.183	Introduction to Statistics	3	92.—	Computer Math/Info Systems Elective	3
—, —, —	Area II Elective	3	—, —, —	Concentration Elective	3
92.—	Computer Math/Info Systems Elective	<u>3</u>	—, —, —	Elective	<u>3</u>
		9			9

Bachelor of Science in Information Systems

Total Credits: 127

In order to receive a Bachelor of Science degree, the student must complete the preceding associate's degree requirements in addition to the following requirements:

No.	Title	Credits	No.	Title	Credits
47.101	General Psychology	3	92.321	Discrete Structures I	3
48.101	Introduction to Sociology	3	92.360	Introduction to Data Structures	3
—, —, —	Human Values Elective	3	92.—	Computer Math/Information Systems Elective	3
—, —, —	Area II Elective	3	92.—	Computer Math/Information Systems Elective	3
—, —, —	Science Elective/ Area III	3	92.—	Computer Math/Information Systems Elective	3
—, —, —	Science Elective/Area III Lab	1	—, —, —	Concentration Elective	3
—, —, —	Elective	3	—, —, —	Concentration Elective	3
—, —, —	Elective	3	—, —, —	Concentration Elective	3
—, —, —	Elective	3	—, —, —	Concentration Elective	3
—, —, —	Elective	3			

Criminal Justice

The University of Massachusetts Lowell offers an Associate of Science degree and a Bachelor of Science degree in Criminal Justice. This program offers a strong concentration in professional courses while simultaneously assuring the student a traditional, well-rounded liberal arts education. The typical student takes between 36 and 48 credits in professional courses.

In addition to this, the student majoring in Criminal Justice will fulfill a professional skills requirement. This consists of either attaining intermediate proficiency in a modern foreign language, or completing four mathematics courses in computers. In the event the student chooses the foreign language skill, the University recommends Spanish.

Associate of Science in Criminal Justice

Years 1-4: Suggested Course of Study
Total Credits: 73

The following course outline which lists 3 courses each semester is only a suggested course load. First year students should not take more than 1 or 2 courses their first semester. Subsequent course loads may be determined by the students' own personal time constraints.

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
First Year					
44.101	The Criminal Justice System	3	—, —, —, —	Skills Requirement	3
42.101	College Writing I	3	42.102	College Writing II	3
47.101	General Psychology	<u>3</u>	—, —, —, —	Area III Science with Lab	<u>4</u>
		9			10
Second Year					
—, —, —, —	Criminal Justice Elective	3	44.221	Criminology I	3
—, —, —, —	Skills Requirement	3	—, —, —, —	Collateral Elective	3
92.—	Area III Math (92.121 Precalculus recommended)	<u>3</u>	—, —, —, —	Area II Elective	<u>3</u>
		9			9
Third Year					
—, —, —, —	Criminal Justice Elective	3	44.234	Criminal Law	3
—, —, —, —	Skills Requirement	3	—, —, —, —	Skills Requirement	3
—, —, —, —	Area III Science or Math	<u>3</u>	48.101	Introduction to Sociology	<u>3</u>
		9			9
Fourth Year					
—, —, —, —	Criminal Justice Elective	3	—, —, —, —	Criminal Justice Elective	3
—, —, —, —	Collateral Elective	3	—, —, —, —	Collateral Elective	3
—, —, —, —	Human Values Elective	<u>3</u>	—, —, —, —	Area II Elective	<u>3</u>
		9			9

Bachelor of Science in Criminal Justice

Years 5-7: Suggested Course of Study

Total Credits: 121

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
Fifth Year					
44.390	Intro. to Criminal Justice Research	3	44.370	Criminal Justice Management	3
—, —, —	Collateral Elective	3	(or 44.371 Criminal Justice Planning)		
—, —, —	Area I or II Elective	<u>3</u>	—, —, —	Collateral Elective	3
		9	—, —, —	Free Elective	<u>3</u>
					9
Sixth Year					
—, —, —	Collateral Elective	3	44.490	Criminal Justice Research Seminar	3
—, —, —	Area I or II Elective	3	—, —, —	Free Elective	3
—, —, —	Free Elective	<u>3</u>	—, —, —	Free Elective	<u>3</u>
		9			9
Seventh Year					
44.—	Criminal Justice Elective	3	44.—	Criminal Justice Elective	3
	(.300/.400 level)			(.300/.400 level)	
—, —, —	Free Elective	<u>3</u>	—, —, —	Free Elective	<u>3</u>
		6			6

Criminal Justice Requirements: 36 - 48 credits

Note: The major in the Bachelor of Science in Criminal Justice consists of at least 36 credits in criminal justice courses, of which at least 15 credits should be at the 300 course level or above.

Collateral Requirements: 18 credits

In addition to the major courses and the professional skills area, Criminal Justice majors should select six courses from the following list of collateral courses. Courses used to fulfill the professional skills requirement may be used toward fulfillment of this requirement. The following is a list of suggested collateral courses from which students may choose:

41.261	Introduction to Legal Concepts	46.356	Public Policy Analysis
41.262	Introduction to Business Law	46.360	Public Administration
41.363	Corporate and Property Law	47.209	Social Psychology
41.369	The Courts and the Constitution	47.232	Psychology of Personality
41.376	Family Law	47.260	Human Development I
41.381	Women and the Law	47.272	Abnormal Psychology
42.382	Crime in Literature	47.360	Human Development II
43.216	American Urban History I	47.364	Psychology of Crime and Corrections
43.217	American Urban History II	48.231	Sociology of the Family
43.268	History of Family and Childhood in the U.S.	48.234	Study of Minorities
43.308	History of Crime, Conflict and Social Control in the U.S.	48.235	Black Experience in American Life
43.335	Quantitative Methods in History and Sociology	48.255	Social Deviance
43.349	English Constitutional and Legal History	48.256	Political Sociology
44.435	Alternative Dispute Resolution	48.341	Social Stratification
45.203	Introduction to Ethics	48.345	Urban Sociology
46.105	Introduction to Public Policy	48.361	Sociology of Law and the Criminal Justice System
46.202	Practical Public Affairs	48.402	Social Research
46.230	Law and the Legal System	92.263	Fortran Programming
46.265	State and Local Politics	92.183	Introduction to Statistics
46.270	Legislative Politics		
46.345	Constitutional Law and Politics	92.265	Pascal Programming
46.347	Civil Liberties, Law and Politics	92.363	SPSS-X (Intro. to Data Analysis)
46.355	Government Fiscal Policy		

(continues...)

All courses in the Criminal Justice major are regarded as professional courses and are not accepted either in transfer or as elective options in other degree programs in the College of Arts and Sciences, except for the following:

44.101	The Criminal Justice System	44.261	Juvenile Delinquency
44.221	Criminology I	44.321	Criminology II
44.234	Criminal Law	44.335	Juvenile Court: Philosophy & Practice

Professional Skills: 12 credits

Students are required to meet proficiency standards in one of the following:*

- a. Intermediate proficiency in a modern foreign language, preferably Spanish, or
- b. Computer Programming and Statistics, proficiency to be demonstrated by passing a minimum of four courses (9 credits in the mathematics department) from the following approved list:

44.201 Computer Applications in Criminal Justice or equivalent

Plus one of the following:

- 92.263 FORTRAN Programming
- 92.265 Pascal Programming
- 92.365 COBOL Programming I

The student completes this requirement by taking the following:

- 92.183 Introduction to Statistics and
- 92.363 SPSS-X (Intro. to Data Analysis)

*The College does not prohibit the completion of both options in the professional skills area.

Free Electives: Remaining credits

Please note that from among all electives, either collateral or free electives that the student presents for graduation, at least 2 must be at the 300 or 400 course level.

There are three main areas of tracks which a student may elect: Enforcement, Law and the Courts, or Corrections. Courses suggested for one track are not exclusive, and some crossover is desirable.

Enforcement

44.101	The Criminal Justice System*+	44.341	Comparative Police Systems
44.141	Police Functions*	44.370	Criminal Justice Management
44.221	Criminology I*+	44.371	Criminal Justice Planning and Evaluation
44.233	Criminal Procedure	44.373	Issues in Police Administration
44.234	Criminal Law*+	44.390	Introduction to Criminal Justice Research+
44.243	Criminalistics I*	44.490	Criminal Justice Research Seminar+
44.244	Criminalistics II	44.496	Practicum+ (In-service students will substitute 44.370 or 44.371)
44.261	Juvenile Delinquency*		

Law and the Courts

44.101	The Criminal Justice System*+	44.360	Gender, Race, and Crime
44.221	Criminology I*+	44.370	Criminal Justice Management
44.233	Criminal Procedure	44.371	Criminal Justice Planning and Evaluation
44.234	Criminal Law*+	44.380	Selected Issues in Criminal Justice
44.261	Juvenile Delinquency*	44.390	Introduction to Criminal Justice Research+
44.321	Criminology II	44.490	Criminal Justice Research Seminar+
44.331	Penal Law	44.496	Practicum+ (In-service students will substitute 44.370 or 44.371)
44.335	Juvenile Court: Philosophy and Practice		
44.354	Probation and Parole	46.230	Law and the Legal System

Corrections

44.101	The Criminal Justice System*+	44.370	Criminal Justice Management
44.151	Introduction to Corrections	44.371	Criminal Justice Planning and Evaluation
44.221	Criminology I*+	44.372	Issues in Correctional Administration
44.233	Criminal Procedure	44.390	Introduction to Criminal Justice Research+
44.234	Criminal Law*+	44.490	Criminal Justice Research Seminar+
44.261	Juvenile Delinquency*	44.496	Practicum+ (In-service students will substitute 44.370 or 44.371)
44.331	Penal Law	46.230	Law and the Legal System
44.351	Community Based Corrections		
44.354	Probation and Parole		

* Associate Degree Courses/ +Bachelor Degree Courses

Bachelor of Science in Criminal Justice: Paralegal Option

Years 1-7: Suggested Course of Study

Total Credits: 121

This course outline which lists 3 courses each semester is only a suggested course load. First year students should not take more than 1 or 2 courses their first semester. Subsequent course loads may be determined by the students' own personal time constraints.

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
First Year					
41.103	Introduction to Paralegal Studies	3	44.301	Computer Applications for the Legal Profession	3
42.101	College Writing I	3	42.102	College Writing II	3
44.101	The Criminal Justice System	<u>3</u>	—, —, —	Area III Science with Lab	<u>4</u>
		9			10
Second Year					
—, —, —	Area III Math Requirement	3	—, —, —	Area I or II Elective	3
—, —, —	Area I or II Elective	3	—, —, —	Skills Requirement	3
46.230	Law & the Legal System	<u>3</u>	44.234	Criminal Law	<u>3</u>
		9			9
Third Year					
—, —, —	Collateral Elective	3	—, —, —	Skills Requirement	3
—, —, —	Skills Requirement	3	—, —, —	Area I or II Elective	3
—, —, —	Area III Science or Math Requirement	<u>3</u>	—, —, —	Human Values Elective	<u>3</u>
		9			9
Fourth Year					
41.390	Litigation	3	—, —, —	Paralegal Elective	3
41.387	Legal Research Methods	3	—, —, —	Collateral Elective	3
—, —, —	Collateral Elective	<u>3</u>	—, —, —	Collateral Elective	<u>3</u>
		9			9
Fifth Year					
41.376	Family Law	3	—, —, —	Area I or II Elective	3
—, —, —	Area I or II Elective	3	—, —, —	Free Elective	3
41.370	Real Estate Law	<u>3</u>	41.363	Corporate and Property Law	<u>3</u>
		9			9
Sixth Year					
—, —, —	Paralegal Elective	3	—, —, —	Free Elective	3
—, —, —	Paralegal Elective	3	—, —, —	Paralegal Elective	3
—, —, —	Area I or II Elective	<u>3</u>	—, —, —	Collateral Elective	<u>3</u>
		9			9
Seventh Year					
44.497	Paralegal Practicum/Internship	3	41.379	Law, Logic, Ethics	3
—	Collateral Elective	<u>3</u>	—, —, —	Free Elective	<u>3</u>
		6			6

(continues...)

Professional Skills: 12 credits

All students must meet proficiency standards in Foreign Language or Professional Skills.

- a. Intermediate Proficiency in a modern foreign language, preferably Spanish (12 credits), or
- b. Professional Skills Option:

No.	Title	Credits
44.301	Computer Applications for the Legal Profession	3
41.387	Legal Research Methods	3
41.379	Law, Logic, and Ethics	3
92.183	Introduction to Statistics	3

Paralegal Option Requirements:

- a. Required Courses:

41.103	Introduction to Paralegal Studies	44.101	The Criminal Justice System
44.234	Criminal Law	44.301	Computer Applications for the Legal Profession
41.261	Introduction to Legal Concepts or	41.363	Corporate and Property Law
46.230	Law and the Legal System	41.376	Family Law
41.370	Real Estate Law	41.387	Legal Research Methods
41.379	Law, Logic, and Ethics	44.497	Paralegal Practicum/Internship
41.390	Litigation		

- b. The student may select an additional 12 credits in the major field. These courses can be chosen from the Criminal Justice Curriculum (44 prefix) and/or from the following approved Paralegal Course List:

41.366	International Law	41.367	Environmental Law & Regulations
41.368	Employment and Labor Law	41.371	Legal Issues in Health Care
46.345	Constitutional Law and Politics	46.347	Civil Liberties, Law, and Politics

Collateral Requirements: 18 credits

In addition to the major courses, the student should select six courses from the following list of collateral courses. Courses used to fulfill the professional skills requirement may be used toward fulfillment of this requirement.

42.382	Crime in Literature	47.209	Social Psychology
43.243	American Urban History I	47.232	Psychology of Personality
43.244	American Urban History II	47.260	Human Development I
43.268	History of the Family and Childhood in the U.S.	47.272	Abnormal Psychology
43.308	History of Crime, Conflict, and Social Control in the U.S.	47.360	Human Development II
43.335	Quantitative Methods in History and Social Sciences	47.364	Psychology of Crime and Corrections
43.349	English Constitution and Legal History	48.231	Sociology of the Family
45.203	Introduction to Ethics	48.234	Study of Minorities
46.105	Introduction to Public Policy	48.235	Black Experience in American Life
46.202	Practical Public Affairs	48.255	Social Deviance
46.265	State and Local Politics	48.256	Political Sociology
46.270	Legislative Politics	48.341	Social Stratification
46.347	Civil Liberties, Law, and Politics	48.345	Urban Sociology
46.355	Government Fiscal Policy	48.361	Sociology of Law and the Criminal Justice System
46.356	Public Policy Analysis	48.402	Social Research
46.360	Public Administration	92.183	Introduction to Statistics
46.410	Reading Seminar in Judicial Review	92.263	Fortran Programming
		92.265	Pascal Programming
		92.363	SPSSX (Introduction to Data Analysis)

Bachelor of Liberal Arts

Total Credits: 120

I. General University Requirements: 33 - 35 credits

Note: If the student's areas of concentration fall under Area I or Area II, he/she must take courses other than those in his/her concentrations to fulfill the core requirements. For example, if a student chooses psychology as the major area of concentration, the student cannot use General Psychology to fill a core requirement.

a. College Writing I and II	6 credits
b. Area I Behavioral and Social Sciences	6 credits
Area II Fine Arts and Humanities	6 credits
plus 6 credits from either Area I or Area II	6 credits
c. Human Values	3 credits
d. Area III Mathematics and Science	9-11 credits
(One Science w/Lab, one Mathematics, and one Science or Mathematics course)	

II. Liberal Arts Major (Minimum 36 credits - Maximum 60 credits)

a. Major Area of Concentration	Minimum 21 credits
b. Second Area of Concentration	Minimum 6 credits
c. Third Area of Concentration	Minimum 6 credits

III. Electives: Remaining credits

Presently, students may select concentrations from Sociology, Psychology, History, and Political Science. Students must earn a 2.20 cumulative grade point average in their areas of concentration by the end of their senior year and must select at least 15 credit hours in 300-level courses or higher. Students selecting Psychology or Sociology as their major area of concentration must take a 400-level seminar which has as its prerequisites the 6 courses (18 credits) previously taken in concentration.

Electives may be chosen from economics, chemistry, science, mathematics, computer mathematics, clinical laboratory sciences, behavioral and social sciences, fine arts and humanities. In addition, the degree courses may also include accounting (67.101, 67.102, 67.203, 67.204) and management (62.201, 69.232, 69.253) courses. Courses of a distinctly professional orientation are not applicable to the Bachelor of Liberal Arts and will not be accepted for degree credit.

Certificate in Computer Proficiency

The following courses are designed to provide the student with a broad-based background in computers. This program provides a strong introductory base and will provide the skills needed to function as a computer professional in a wide variety of work situations. The need for professionals with a strong computer background will continue to increase as business, government, schools, and scientific organizations seek new applications for computers and improvements to software already in use.

Many of the courses in this certificate program can be applied towards the A.S. or B.S. degree in Information Systems.

Required Courses:

- 92.202 Microcomputers & Applications Software
- 92.265 Pascal Programming (or 92.211 Introduction to Programming Using "C")

Electives (Choose 3):

- | | |
|--|--|
| 92.219 Basic Programming | 92.364 Problem Solving with C |
| 92.263 Fortran Programming | 92.365 Cobol Programming I |
| 92.267 C Programming | 92.368 Cobol Programming II |
| 92.268 C++ Programming | 92.461 Systems Simulation and Modeling |
| 92.311 Introduction to the UNIX Operating System | 92.468 Microcomputer Principles and Applications |
| 92.321 Discrete Structures I | 92.470 Data/Telecommunications |
| 92.360 Introduction to Data Structures | 92.474 Data Base Concepts |
| 92.363 Intro to Data Analysis (SPSSX) | |

Certificate in Data/Telecommunications

This program trains participants for positions as entry-level network administrators, LAN troubleshooters, technicians who can establish a LAN in an office environment, and systems analysts responsible for networking functions in large or small companies.

Many of the courses in this certificate program can be applied towards the A.S. or B.S. degree in Information Systems.

Required Courses:

- | | |
|--|---|
| 92.267 C Programming | 92.472 Local Area Networks |
| 92.311 Introduction to the UNIX Operating System | 92.473 Computer Network Architecture and Protocol |
| 92.470 Data/Telecommunications | 92.475 Communication Network Management |

Certificate in Paralegal Studies

The U.S. Bureau of Labor Statistics indicates that the fastest growing occupation during the 1990's will be the paralegal profession. In fact, current estimates project job opportunities for paralegals to double by the year 1995. More and more firms require training for the paralegals they hire. The certificate is an opportunity to gain the skills needed to work in a legal environment, whether a law firm, bank, insurance company, court system, or one of the many corporate legal departments currently hiring paralegals. UMass Lowell's program emphasizes a unique mix of law theory and practical skills applications. Two features of special interest in this program are the course in Computer Applications for the Legal Professional and an internship that provides hands-on training. To be accepted as candidates, all applicants must have completed 45 hours of general college study or two years of work experience in a legal setting.

All of the courses in this certificate program can be applied to the B.S. degree in Criminal Justice: Paralegal Option.

Required Courses:

41.103	Introduction to Paralegal Studies	41.390	Litigation
41.387	Legal Research Methods	44.301	Computer Applications for the Legal Profession

Electives (Choose 3):

41.363	Corporate and Property Law	44.287	Legal Writing for Paralegals
41.370	Real Estate Law	44.435	Alternative Dispute Resolution
41.376	Family Law	44.497	Paralegal Practicum/Internship
41.391	Federal Taxation Law		

Certificate in Security Management

Courses combine practical instruction by experienced professionals with hands-on training in the latest security applications. Students are provided an in-depth understanding of the security field and an exposure to the methods currently available to protect corporate assets. Graduates of this program will be able to design, implement, and supervise corporate security programs.

Many of the courses in this certificate program can be applied towards the A.S. or B.S. degree in Criminal Justice.

Required Courses:

44.111	Introduction to Industrial Security	44.241	Principles of Investigation
44.201	Computer Applications in Criminal Justice	44.312	Security Management
44.211	Physical Security		

Electives (Choose 2):

19.401	Occupational Health	67.101	Accounting Principles I
23.310	Industrial Safety	67.102	Accounting Principles II
44.234	Criminal Law	69.251	Personnel Management
44.385	Crime and Mental Illness	84.111	General Chemistry I
47.272	Abnormal Psychology	90.457	Computer Ethics and Security

Certificate in Technical Writing

This program trains participants to become proficient in desktop publishing, hypertext, software documentation, micro-computer and application software as well as programming languages, using UMass Lowell's VAX system and PC computer labs. Students learn how to use the most current technologies and processes. Special internship opportunities are available.

Required Courses:

42.401	Principles of Technical Writing	42.403	Advanced Software Writing
42.402	Software Writing	92.202	Microcomputer and Applications Software

Electives (Choose 2):

42.301	Topics In Writing: Desktop Publishing and a Computer Elective or
--- --	2 Computer Electives

Certificate in UNIX

This program provides professionals with a working knowledge of UNIX principles and training in the operating system, which is becoming the standard of choice by companies and organizations interested in improving efficiency and cost containment. Students learn skills that are immediately applicable in the workplace as well as "C" Programming, the language in which most networking software is written. Those currently in the computer industry may use the program to upgrade their skills. Basic computer literacy, or the Certificate Program in Computer Proficiency, is a prerequisite.

Many of the courses in this certificate program can be applied towards the A.S. or B.S. degree in Information Systems.

Required Courses:

92.267	C Programming	92.312	UNIX Shell Programming
92.311	Introduction to the UNIX Operating System	92.360	Introduction to Data Structures

Electives (Choose 1):

92.268	C++ Programming	92.316	UNIX System Administration
92.313	UNIX Internals Overview	92.317	Developing Portable Applications
92.314	UNIX System Interface Programming		

The James B. Francis College of Engineering

The James B. Francis College of Engineering offers the following Continuing Education undergraduate programs:

Associate's and Bachelor's Degree Programs:

Civil Engineering Technology, A.S., B.S.	96-97
Environmental Option, B.S.	98
Surveying Option, A.S.	99
Wastewater Treatment Option, A.S.	99
Water Treatment Option, A.S.	100
Electronic Engineering Technology, A.S., B.S.	101-102
Mechanical Engineering Technology, A.S., B.S.	103-104
Manufacturing Option, B.S.	105

Certificate Programs:

Environmental Technology	106
Manufacturing Technology	106
Plastics Engineering Technology	107
Quality Assurance	107
Wastewater Treatment	108
Water Treatment	108

Engineering Technology

Engineering Technology is that part of the technology field that requires the application of scientific and engineering knowledge and methods combined with technical skills in support of engineering activities; it lies in the occupation spectrum between the craftsman and the engineer at the end of the spectrum closest to the engineer. Engineering Technology programs are primarily concerned with producing graduates to work with and manage machines, materials, processes, people and money for industrial firms. Engineering technicians or technologists may work in such areas as product sales and distribution, operation service and maintenance, manufacturing and production, and routine design.

The curriculum in Engineering Technology places less emphasis on abstract mathematics and general scientific principles and greater stress on the applications of these tools to the solution of practical problems. The technology disciplines emphasize specific technical areas leading to development of specific skills that can be applied immediately upon entry into a career.

Civil Engineering Technology

The Civil Engineering Technology curriculum is designed to provide students with a balanced foundation in physical and mathematical sciences, various fields in civil engineering technology, computer usage, social sciences and the humanities. The subject matter covered in this program is generally similar to that covered in the Civil Engineering curriculum but with less emphasis on theory and greater concentration on application.

The graduates from this program are generally employed as technologists and entry level professionals in fields such as construction and design of buildings, industrial facilities, roadways, tunnels, bridges, environmental projects, land development, substructure investigations, and material testing.

Associate of Science in Civil Engineering Technology

Years 1-4: Suggested Course of Study

Total Credits: 68

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
First Year					
92.121	Precalculus Mathematics	3	92.115	College Trigonometry	3
23.101	Engineering Graphics I	2	15.113	CAD	2
92.211	Intro to Programming with C	<u>3</u>	42.101	College Writing I	<u>3</u>
		8			8
Second Year					
15.123	Surveying I	4	15.124	Surveying II	4
92.125	Calculus A	3	92.126	Calculus B	3
99.131	Technical Physics I	<u>3</u>	15.237	Statics	<u>3</u>
		10			10
Third Year					
99.132	Technical Physics II	3	15.239	Strength of Materials	3
15.246	Fluid Mechanics/Hydraulics	3	15.247	Hydraulics Laboratory	1
42.102	College Writing II	<u>3</u>	42.226	Technical and Scientific Communication	<u>3</u>
		9			7
Fourth Year					
Area II Elective		3	15.257	Highway Elements	3
15.251	Structural Analysis I	3	15.242	Steel Design I	3
15.253	Reinforced Concrete I	<u>3</u>	15.224	Materials/Structural Laboratory	<u>1</u>
		9			7

Bachelor of Science in Civil Engineering Technology

Years 5-8: Suggested Course of Study

Total Credits: 134

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
Fifth Year					
84.111	General Chemistry I	3	15.392	Soil Mechanics II	3
84.113	General Chemistry Laboratory I	1	15.394	Soil Mechanics Laboratory	1
15.254	Soil Mechanics I	<u>3</u>	15.383	Steel Design II	<u>3</u>
		7			7
Sixth Year					
15.356	Water Treatment	3	15.391	Reinforced Concrete II	3
99.133	Technical Physics III	3	15.238	Dynamics	3
92.225	Calculus C	<u>3</u>	15.263	Wastewater Treatment Lab I	<u>1</u>
		9			7
Seventh Year					
49.201	Economics I (Microeconomics)	3	15.352	Structural Analysis II	3
17.130	Electrical Basics and Laboratory	3	49.202	Economics II (Macroeconomics)	3
92.386	Statistics for Science and Engineering	<u>3</u>	--- --	Area II Elective	<u>3</u>
		9			9
Eighth Year					
15.463	Construction Technology	3	--- --	Technical Elective	3
23.414	Engineering Economics	3	15.486	Transportation Elements	3
--- --	Human Values Elective	<u>3</u>	--- --	Area I or II Elective	<u>3</u>
		9			9

Bachelor of Science in Civil Engineering Technology: Environmental Option

Years 1-8: Suggested Course of Study

Total Credits: 136

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
First Year					
92.121	Precalculus Mathematics	3	15.113	CAD	2
23.101	Engineering Graphics I	2	92.115	College Trigonometry	3
92.211	Intro to Programming with C	<u>3</u>	42.101	College Writing I	<u>3</u>
		8			8
Second Year					
15.123	Surveying I	4	15.124	Surveying II	4
92.125	Calculus A	3	92.126	Calculus B	3
99.131	Technical Physics I	<u>3</u>	15.237	Statics	<u>3</u>
		10			10
Third Year					
99.132	Technical Physics II	3	15.239	Strength of Materials	3
15.246	Fluid Mechanics/Hydraulics	3	15.247	Hydraulics Laboratory	1
42.102	College Writing II	<u>3</u>	42.226	Technical and Scientific Communication	<u>3</u>
		9			7
Fourth Year					
--- --	Area II Elective	3	15.257	Highway Elements	3
15.251	Structural Analysis I	3	15.242	Steel Design I	3
15.253	Reinforced Concrete I	<u>3</u>	15.224	Materials/Structural Laboratory	<u>1</u>
		9			7
Fifth Year					
84.121	Chemistry I	3	84.122	Chemistry II	3
15.254	Soil Mechanics I	3	15.280	Industrial Waste Treatment	3
92.225	Calculus C	<u>3</u>	15.394	Soil Mechanics Laboratory	<u>1</u>
		9			7
Sixth Year					
15.356	Water Treatment	3	15.358	Wastewater Treatment	3
15.238	Dynamics	3	15.396	Groundwater Resources	3
15.340	Hazardous Waste Management	<u>3</u>	15.263	Wastewater Treatment Lab I	<u>1</u>
		9			7
Seventh Year					
49.201	Economics I (Microeconomics)	3	49.202	Economics II (Macroeconomics)	3
--- --	Technical Elective	3	15.378	Air Quality Management	3
92.386	Statistics for Science and Engineering	<u>3</u>	--- --	Area II Elective	<u>3</u>
		9			9
Eighth Year					
15.420	Solid Waste Management	3	41.367	Environmental Law and Regulations	3
23.414	Engineering Economics	3	15.470	Project Management	3
--- --	Human Values Elective	<u>3</u>	--- --	Area I or II Elective	<u>3</u>
		9			9

Associate of Science in Civil Engineering Technology: Surveying Option

Years 1-4: Suggested Course of Study

Total Credits: 70

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
First Year					
92.121	Precalculus Mathematics	3	92.115	College Trigonometry	3
23.101	Engineering Graphics I	2	15.113	CAD	2
92.211	Intro to Programming with C	<u>3</u>	42.101	College Writing I	<u>3</u>
		8			8
Second Year					
15.123	Surveying I	4	15.124	Surveying II	4
92.125	Calculus A	3	92.126	Calculus B	3
99.131	Technical Physics I	<u>3</u>	15.237	Statics	<u>3</u>
		10			10
Third Year					
99.132	Technical Physics II	3	15.239	Strength of Materials	3
15.246	Fluid Mechanics/Hydraulics	3	--- --	Area II Elective	3
42.102	College Writing II	<u>3</u>	42.226	Technical & Scientific Communication	<u>3</u>
		9			9
Fourth Year					
15.254	Soil Mechanics I	3	15.257	Highway Elements	3
15.299	Surveying III	3	15.224	Materials/Structural Lab	1
15.262	Legal Aspects of Land Surveying	<u>3</u>	15.264	Fundamentals of Land Development	<u>3</u>
		9			7

Associate of Science in Civil Engineering Technology: Wastewater Treatment Option

Years 1-4: Suggested Course of Study

Total Credits: 70

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
First Year					
92.121	Precalculus Mathematics	3	92.115	College Trigonometry	3
23.101	Engineering Graphics	2	15.113	CAD	2
92.211	Intro to Programming with C	<u>3</u>	42.101	College Writing I	<u>3</u>
		8			8
Second Year					
15.123	Surveying I	4	15.152	Water Biology	3
92.125	Calculus A	3	15.237	Statics	3
86.131	Environmental Chemistry I	<u>3</u>	92.126	Calculus B	<u>3</u>
		10			9
Third Year					
15.261	Wastewater Treatment Plant Operations I	3	15.239	Strength of Materials	3
15.246	Fluid Mechanics/ Hydraulics	3	15.263	Wastewater Treatment Lab I	1
42.102	College Writing II	<u>3</u>	42.226	Technical and Scientific Communication	<u>3</u>
		9			7
Fourth Year					
15.361	Wastewater Treatment Plant Operations II	3	15.363	Wastewater Treatment Lab II	1
15.452	Operation & Maintenance of Wastewater Collection Systems	3	15.492	Water/Wastewater Plant Management	3
--- --	Technical Elective	3	15.280	Industrial Waste Treatment	<u>3</u>
--- --	Area II Elective	<u>3</u>			
		12			7

Associate of Science in Civil Engineering Technology: Water Treatment Option

Years 1-4: Suggested Course of Study
Total Credits: 70

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
First Year					
92.121	Precalculus Mathematics	3	92.115	College Trigonometry	3
23.101	Engineering Graphics I	2	15.113	CAD	2
92.211	Intro to Programming with C	3	42.101	College Writing I	3
		8			8
Second Year					
15.123	Surveying I	4	15.152	Water Biology	3
92.125	Calculus A	3	15.237	Statics	3
86.131	Environmental Chemistry I	3	92.126	Calculus B	3
		10			9
Third Year					
15.272	Water Supply and Treatment Operations I	3	15.239	Strength of Materials	3
15.246	Fluid Mechanics/Hydraulics	3	15.274	Water Works Operations Lab I	1
42.102	College Writing II	3	42.226	Technical and Scientific Communication	3
		9			7
Fourth Year					
15.355	Water Distribution Systems	3	86.132	Environmental Chemistry II	3
15.372	Water Supply & Treatment Operations II	3	15.374	Water Works Operations Lab II	1
--- --	Technical Elective	3	15.492	Water/Wastewater Plant Management	3
--- --	Area II Elective	3			
		12			7

Electronic Engineering Technology

The Electronic Engineering Technology program has, over the years, adjusted to area students and the high technology industry. It can accommodate virtually all types of students, from those who wish to minimize the calculus content and terminate with the associate degree, to those who wish to specialize by taking fairly high-level technical electives and eventually obtain the baccalaureate degree.

Associate of Science in Electronic Engineering Technology

Years 1-4: Suggested Course of Study

Total Credits: 64

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
First Year					
42.101	College Writing I	3	42.102	College Writing II	3
92.121	Precalculus Mathematics	3	92.115	College Trigonometry	3
—, —, —	Area I or II Elective	<u>3</u>	92.267	C Programming	<u>3</u>
		9			9
Second Year					
17.213	Electric Circuits	3	17.214	Circuits and Laboratory I	2
92.125	Calculus A	3	92.126	Calculus B	3
42.226	Technical and Scientific Communication	<u>3</u>	99.131	Technical Physics I	<u>3</u>
		9			8
Third Year					
17.215	Circuits and Laboratory II	2	17.216	Advanced Circuits	3
17.355	Electronics and Laboratory I	2	17.356	Electronics and Laboratory II	2
99.132	Technical Physics II	<u>3</u>	17.346	Logic Design A	<u>3</u>
		7			8
Fourth Year					
17.350	Control Systems I	3	17.353	Digital Electronics	3
17.357	Electronics and Laboratory III	2	17.358	Electronics and Laboratory IV	2
17.383	Microprocessors A	<u>2</u>	17.384	Microprocessors B	<u>2</u>
		7			7

Students enrolling in this program should purchase an electronic calculator capable of handling logarithmic and trigonometric functions. The use of the calculator will be an integral part of courses 17.213 and 17.214, where proficiency will be developed. Competency in the use of the calculator will be assumed in all subsequent E.E.T. courses.

Proper approval for a 17.4— course is automatically assumed if all prerequisites are satisfied. Proper approval for Area I, Area II or Human Values courses is automatically assumed if all prerequisites are satisfied and the course is selected from those listed in this catalog. Any changes to the list of approved courses will be posted in the Office of Enrollment Services. Proper approval for course substitution or other deviation from the above can be obtained only by written permission.

Bachelor of Science in Electronic Engineering Technology

Years 5-8: Suggested Course of Study

Total Credits: 131

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
Fifth Year					
17.347	Logic Design B	3	17.361	Project Laboratory A	2
17.365	Applied Linear Devices	3	92.268	C++ Programming	3
92.225	Calculus C	<u>3</u>	92.226	Calculus D	<u>3</u>
		9			8
Sixth Year					
17.348	Logic Design C & Laboratory	2	17.230	Mathematics & Statistics/E.E.T.	3
92.234	Differential Equations	3	17.368	Data Conversion & Laboratory	2
99.133	Technical Physics III	<u>3</u>	17.376	Electromagnetic Theory I	<u>3</u>
		8			8
Seventh Year					
17.4—	E.E.T. Elective	3	17.4—	E.E.T. Elective	3
17.4—	E.E.T. Elective	3	—, — —	Human Values Elective*	3
—, — —	Area II Elective	<u>3</u>	—, — —	Area II Elective	<u>3</u>
		9			9
Eighth Year					
49.201	Economics I (Microeconomics)	3	49.202	Economics II (Macroeconomics)	3
17.391	Project Laboratory B	2	17.392	Project Laboratory C	2
17.4—	E.E.T. Elective	<u>3</u>	17.4—	E.E.T. Elective	<u>3</u>
		8			8

* Must appear on both the Human Values, and either the Area I or Area II Elective list.

Mechanical Engineering Technology

The Mechanical Engineering Technology program at the University of Massachusetts Lowell has been developed to provide the student with a broad background in scientific and engineering technology and the technical skills needed to support engineering activities. The program's emphasis is on applications with hands-on experience rather than theory. Technical courses typically concentrate in the fields of energy, mechanics, and manufacturing. Energy deals with production, transport, and final storage. Mechanics is concerned with the behavior of solids and fluids such as mechanics of mechanism or aerodynamics. Manufacturing concentrates on basic as well as advanced techniques used in modern manufacturing organizations.

The Mechanical Engineering Technology program offers the student a spectrum of exciting career opportunities in manufacturing, plant management, product testing and evaluation, quality assurance, maintenance, and field support operations.

Associate of Science in Mechanical Engineering Technology

Years 1-4: Suggested Course of Study

Total Credits: 66

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
First Year					
92.121	Precalculus Mathematics	3	92.115	College Trigonometry	3
23.101	Engineering Graphics I	2	23.102	Engineering Graphics II	2
42.101	College Writing I	<u>3</u>	42.102	College Writing II	<u>3</u>
		8			8
Second Year					
92.125	Calculus A	3	92.126	Calculus B	3
99.131	Technical Physics I	3	99.132	Technical Physics II	3
42.226	Technical and Scientific Communication	<u>3</u>	92.211	Intro to Programming with C	<u>3</u>
		9			9
Third Year					
23.200	CADrf (Computer Aided Drafting)	3	17.130	Electrical Basics and Lab	2
23.221	Statics	3	23.222	Dynamics	3
23.241	Elements of Thermodynamics I	<u>3</u>	23.223	Mechanics of Materials I	<u>3</u>
		9			8
Fourth Year					
23.242	Applied Fluid Mechanics	3	17.131	Electronic Basics and Lab	2
23.320	Machine Design	3	— — —	Area II Elective	3
23.202	Thermo/Fluids Lab	<u>2</u>	23.302	Mechanics Materials Lab	<u>2</u>
		8			7

Bachelor of Science in Mechanical Engineering Technology

Years 5-8: Suggested Course of Study

Total Credits: 134

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
Fifth Year					
99.133	Technical Physics III	3	17.132	Digital Basics and Lab	2
92.225	Calculus C	3	92.226	Calculus D	3
84.111	General Chemistry I	<u>3</u>	23.354	Problems in M.E.T.	<u>3</u>
		9			8
Sixth Year					
23.295	Materials Science	3	47.101	General Psychology	3
84.113	General Chemistry Lab I	1	23.243	Elements of Thermodynamics II	3
92.386	Statistics for Science and Engineering	<u>3</u>	-- --	Area II and Human Values Elective	<u>3</u>
		7			9
Seventh Year					
49.201	Economics I (Microeconomics)	3	49.202	Economics II (Macroeconomics)	3
23.475	Heat Transfer	3	23.480	CADes	3
-- --	Area II Elective	<u>3</u>	23.4--	M.E.T. Elective	<u>3</u>
		9			9
Eighth Year					
23.414	Engineering Economics	3	23.481	Applied CAD Design	3
23.402	Engineering Measurement Lab	2	-- --	Technical Elective	3
-- --	Technical Elective	<u>3</u>	23.4--	M.E.T. Elective	<u>3</u>
		8			9

Proper approval for a 23.4 - - course is automatically assumed if all prerequisites are satisfied. Proper approval for Area I, Area II or Human Values courses is automatically assumed if all prerequisites are satisfied and the course is selected from those listed in this catalog. Any changes to the list of approved courses will be posted in the Office of Enrollment Services. Proper approval for course substitution or other deviation from the above may be obtained by written permission.

Bachelor of Science in Mechanical Engineering Technology: Manufacturing Option

Years 5-8: Suggested Course of Study

Total Credits: 133

Upon completion of the Associate of Science requirements in Mechanical Engineering Technology, students may elect the Bachelor of Science in Mechanical Engineering Technology: Manufacturing Option.

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
Fifth Year					
99.133	Technical Physics III	3	17.132	Digital Basics and Lab	2
92.225	Calculus C	3	92.226	Calculus D	3
84.111	General Chemistry I	3	23.301	Manufacturing Technology Lab	2
		9			7
Sixth Year					
23.295	Materials Science	3	47.101	General Psychology	3
84.113	General Chemistry Lab I	1	23.243	Elements of Thermodynamics II	3
92.386	Statistics for Science and Engineering	3	— — —	Area II and Human Values Elective	3
		7			9
Seventh Year					
49.201	Economics I (Microeconomics)	3	49.202	Economics II (Macroeconomics)	3
23.475	Heat Transfer	3	23.480	CADes	3
— — —	Area II Elective	3	23.4—	M.E.T. Elective	3
		9			9
Eighth Year					
23.414	Engineering Economics	3	23.419	CAM	3
23.402	Engineering Measurement Lab	2	23.4—	Mfg. Technology Elective	3
23.416	Statistical Quality Control	3	23.305	Manufacturing Processes OR	3
		8	23.306	Electronics Mfg. Technology	9

Certificate in Environmental Technology

This certificate program is designed for students with a technical background who are interested in focusing on environmental issues, for technicians and support personnel employed in safety, laboratory, physical plant, distribution, transportation, drafting, public works or health board functions, and for consultants. In addition, this program provides updated information to engineers in various disciplines who need to understand current environmental laws and compliance technologies. Program graduates might expect to assist in projects such as air pollution control, resource recovery, analytical services, hazardous waste management, waste management, water infrastructure, instrument manufacturing, and water utilities development.

Many of the courses in this certificate program can be applied towards the B.S. degree in Civil Engineering Technology: Environmental Option.

Required Courses:

15.340	Hazardous Waste Management	84.121	Chemistry I
15.378	Air Quality Management	84.122	Chemistry II
15.420	Solid Waste Management		

Electives (Choose 2):

15.280	Industrial Waste Treatment	41.367	Environmental Law and Regulations
15.356	Water Treatment	87.103	Earth and Its Environment
15.358	Wastewater Treatment		

Certificate in Manufacturing Technology

Focusing on the technology of manufacturing processes, this program is designed to correlate theoretical knowledge and the real world environment of manufacturing technology. It gives students a broad understanding of manufacturing environments and automation methods. Participation in the program will prepare students for career advancement opportunities, including positions such as foreman, junior engineer and analyst. Experienced engineers and managers may use this program to update their skills through the application of current manufacturing technology.

Many of the courses in this certificate program can be applied towards the B.S. degree in Mechanical Engineering Technology: Manufacturing Option.

Required Courses:

23.200	Computer Aided Drafting	23.416	Statistical Quality Control
23.305	Manufacturing Processes	23.419	CAM Systems
(or 23.306 Electronics Manufacturing Technology)			

Electives (Choose 3):

23.301	Manufacturing Technology Lab	23.427	Plant Layout and Materials Handling
23.310	Industrial Safety	23.474	Design for Manufacture
23.314	Manufacturing Productivity (Total Quality in Manufacturing)	23.480	Computer Aided Design
23.402	Engineering Measurement Lab	92.386	Statistics for Science and Engineering

Certificate in Plastics Engineering Technology

Competitive manufacturing systems are becoming increasingly vital in the changing global economy. Important components of the manufacturing processes are state-of-the-art plastics technology and trained plastics engineers and technologists. This program provides professional training for students needing theoretical and technical information about the plastics industry. Practical instruction covers materials, processing and design engineering. This program should particularly benefit technicians, process engineers, technologists and program development specialists.

Required Courses:

27.201	Plastics Material Science I	27.373	Plastics Mold Engineering I
27.202	Plastics Material Science II	27.401	Processing Technology I
27.217	Plastics Processing Engineering Lab	27.402	Processing Technology II

Electives (Choose 2):

27.203	Plastics Material Science III	27.407	Plastics Industry Organization
27.301	Additives for Polymeric Materials	27.418	Product Design
27.303	Reinforced Plastics and Composites	27.425	Dynamic Mechanical Properties of Plastics I
27.376	Plastics Mold Engineering II	27.426	Dynamic Mechanical Properties of Plastics II
27.403	Physical Properties of Polymers I	27.440	Commercial Development of Polymeric Material Systems
27.404	Physical Properties of Polymers II	27.451-.458	Selected Topics I - VIII
27.405	Polymer Characterization		
27.406	Polymer Structures		

Certificate in Quality Assurance

As large U.S. companies incorporate the techniques of total quality, small business suppliers will be affected. Large and small businesses will need workers trained in statistics, experimentation and quality control in order to establish and meet tougher manufacturing standards. Companies will need workers who can understand and apply the current series of international standards for product control used in Europe and Japan—ISO 9000. The Certificate in Quality Assurance will provide engineers, technicians, and people working in manufacturing the training necessary to meet increasingly stringent customer demands and to make significant contributions to American companies as they improve the design, production, inspection, packaging and marketing of their products.

Required Courses:

23.262	Engineering Data Analysis	23.416	Statistical Quality Control
23.314	Manufacturing Productivity (Total Quality in Manufacturing)	23.426	Quality Systems Certification/ISO 9000

Electives (Choose 3):

19.401	Occupational Health	23.450	Reliability Engineering
23.310	Industrial Safety	23.474	Design for Manufacture
23.318	Logistics Engineering	23.485	Advanced Quality Assurance
23.402	Engineering Measurement Laboratory	23.486	Managing Total Quality Through Teams
23.418	Quality Work Teams		

Certificate in Wastewater Treatment

This program prepares students for all levels of state certification required to manage and operate a modern wastewater treatment facility. Courses are provided for both municipal (biological) plants and industrial (physical/chemical) treatment plant operations. The program is designed for students seeking to enter the field of wastewater management and for those in the field who wish to achieve higher state certification levels.

Many of the courses in this certificate program can be applied towards the A.S. degree in Civil Engineering Technology: Wastewater Option.

Required Courses:

15.261	Wastewater Treatment Plant Operations I	15.361	Wastewater Treatment Plant Operations II
15.263	Wastewater Treatment Lab I	15.363	Wastewater Treatment Lab II
15.280	Industrial Waste Treatment		

Electives (Choose 2):

15.152	Water Biology	15.492	Water/Wastewater Plant Management
15.388	Pumps and Compressors	86.131	Environmental Chemistry I
15.452	Operation and Maintenance of Wastewater Collection Systems	86.132	Environmental Chemistry II

Certificate in Water Treatment

The specialized courses in this certificate program provide students with the technical knowledge to operate and maintain physical-chemical water treatment facilities and water distribution systems, and will prepare students for all levels of the Massachusetts water treatment certification examination. The program is designed to enable professionals already in the field to achieve higher certificate levels and will provide career training for those wishing to enter the field.

Many of the courses in this certificate program can be applied towards the A.S. degree in Civil Engineering Technology: Water Option.

Required Courses:

15.272	Water Supply and Treatment Operations I	15.372	Water Supply and Treatment Operations II
15.274	Water Works Operations Lab I	86.131	Environmental Chemistry I
15.355	Water Distribution Systems		

Electives (Choose 2):

15.152	Water Biology	15.492	Water/Wastewater Plant Management
15.374	Water Works Operations Lab II	86.132	Environmental Chemistry II
15.388	Pumps and Compressors		

College of Management

The College of Management offers Associate of Science degrees in Accounting, Banking, and Management. These degrees are intended to prepare students for a variety of entry-level positions in business or to facilitate a career move into the business environment. In addition to the basic functional areas in business, including accounting, finance, management and marketing, the programs offer several contemporary elective courses in relevant business areas such as entrepreneurship, leadership, and total quality management.

Students considering continued business education after the associate's degree should choose the Management program to allow for maximum transferability of courses into a Bachelor of Science in Management degree program. Students who wish to continue their studies at the University in the College of Management or who want more specific information about such programs should see an advisor in the Division of Continuing Education.

Associate's Degrees:

Accounting, A.S.	110
Banking, A.S.	111
Management, A.S.	112

Certificate Programs:

Accounting	113
Banking	113
Purchasing Management	113

Associate of Science in Accounting

Years 1-4: Suggested Course of Study

Total Credits: 64

This course outline which lists 3 courses each semester is only a suggested course load. First year students should not take more than 1 or 2 courses their first semester. Subsequent course loads may be determined by the students' own personal time constraints.

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
First Year					
67.101	Accounting Principles I*	3	67.102	Accounting Principles II*	3
49.201	Economics I (Microeconomics)	3	49.202	Economics II (Macroeconomics)	3
42.101	College Writing I	<u>3</u>	42.102	College Writing II	<u>3</u>
		9			9
Second Year					
69.201	Principles of Management	3	48.101	Introduction to Sociology	3
67.103	Accounting Principles III*	3	62.203	Intermediate Accounting I	3
90.112	Concepts in Algebra I	<u>3</u>	90.119	Concepts in Algebra II	<u>3</u>
		9			9
Third Year					
46.--	Political Science Elective	3	--.--	Science Elective/Area III	3
			--.--	Science Elective/Area III Lab	1
47.101	General Psychology	3	67.206	Cost Accounting	3
67.204	Intermediate Accounting II	<u>3</u>	--.--	History Elective from Area II list	<u>3</u>
		9			10
Fourth Year					
69.231	Business Finance	3			
67.209	Federal Income Taxes	3			
--.--	Free Elective	<u>3</u>			
		9			

* The traditional 2-course day school sequence in Accounting (60.201 Accounting/Financial and 60.202 Accounting/Managerial) will also be offered allowing stronger students in accounting to replace 67.103 Accounting Principles III with a free elective.

Associate of Science in Banking

Years 1-4: Suggested Course of Study

Total Credits: 63

This course outline which lists 3 courses each semester is only a suggested course load. First year students should not take more than 1 or 2 courses their first semester. Subsequent course loads may be determined by the students' own personal time constraints.

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
First Year					
69.101	Principles of Banking	3	69.117	Law and Banking: Principles OR	3
			41.262	Introduction to Business Law	
67.101	Accounting Principles I	3	67.102	Accounting Principles II	3
42.101	College Writing I	<u>3</u>	42.102	College Writing II	<u>3</u>
		9			9
Second Year					
42.224	Business Writing	3	69.105	Consumer Lending	3
49.201	Economics I (Microeconomics)	3	49.202	Economics II (Macroeconomics)	3
90.112	Concepts in Algebra I	<u>3</u>	90.119	Concepts in Algebra II	<u>3</u>
		9			9
Third Year					
69.119	Commercial Lending	3	69.231	Business Finance	3
47.101	General Psychology	3	— — —	Area II Elective	3
92.202	Microcomputers and Applications Software	<u>3</u>	49.211	Statistics for Business and Economics	<u>3</u>
		9			9
Fourth Year					
69.232	Money and Banking	3			
69.271	Operations Management	3			
69.—	Banking Elective	<u>3</u>			
		9			

Associate of Science in Management

Years 1-4: Suggested Course of Study

Total Credits: 64

This course outline which lists 3 courses each semester is only a suggested course load. First year students should not take more than 1 or 2 courses their first semester. Subsequent course loads may be determined by the students' own personal time constraints.

First Semester			Second Semester		
No.	Title	Credits	No.	Title	Credits
First Year					
67.101	Accounting Principles I*	3	67.102	Accounting Principles II*	3
49.201	Economics I (Microeconomics)	3	49.202	Economics II (Macroeconomics)	3
42.101	College Writing I	<u>3</u>	42.102	College Writing II	<u>3</u>
		9			9
Second Year					
69.253	Intro to Management & Organizational Behavior	3	48.101	Introduction to Sociology	3
46.--	Political Science Elective	3	--- --	Science Elective/Area III	3
90.112	Concepts in Algebra I	<u>3</u>	--- --	Science Elective/Area III Lab	1
		9	90.119	Concepts in Algebra II	<u>3</u>
					10
Third Year					
67.103	Accounting Principles III*	3	62.201	Marketing Principles	3
47.101	General Psychology	3	--- --	Business Elective	3
--- --	Free Elective	<u>3</u>	--- --	History Elective from Area II list	<u>3</u>
		9			9
Fourth Year					
69.231	Business Finance	3			
--- --	Free Elective	3			
--- --	Free Elective	<u>3</u>			
		9			

* The traditional 2-course day school sequence in Accounting (60.201 Accounting/Financial and 60.202 Accounting/Managerial) will also be offered allowing stronger students in accounting to replace 67.103 Accounting Principles III with a free elective.

Certificate in Accounting

The following courses offer exposure to financial and managerial accounting, for profit and nonprofit organizations. The program prepares students both for managerial responsibilities and for the accountant's role in compiling and reporting data to a company's decision makers.

Required Courses:

67.101	Accounting Principles I	67.206	Cost Accounting
67.102	Accounting Principles II	69.231	Business Finance
67.203	Intermediate Accounting I		

Electives (Choose 2):

67.204	Intermediate Accounting II	67.209	Federal Income Taxes
67.207	Auditing	67.280	Accounting for Not-for-Profit Institutions

Certificate in Banking

Designed for bank personnel such as customer service representatives, mid-management and retail banking staff interested in advancement opportunities, and adults seeking to enter the banking field. The Certificate in Banking provides state-of-the-art training for today's increasingly competitive banking environment. The program provides banking professionals with the management tools needed to cope with a complex business environment.

Required Courses:

42.224	Business Writing	69.105	Consumer Lending
67.101	Accounting Principles I	69.117	Law and Banking: Principles
69.101	Principles of Banking	69.127	Financial Planning

These courses can be applied towards the University's Associate degree in Banking. With the exception of the Business Writing course, all courses apply to the American Institute of Banking's General Banking Diploma (which requires six courses) and also to AIB's Consumer Credit Diploma (which requires nine courses).

Certificate in Purchasing Management

This program introduces students to contemporary issues in purchasing management, an integral part of managing a business. New trends are examined, including the increasing importance of international purchasing. Courses in this program will help adults prepare for a purchasing career and will aid those already in the field to remain current and retain their purchasing manager certification.

Required Courses:

60.202	Accounting/Managerial	69.281	Purchasing Principles
69.271	Operations Management	69.275	Total Quality Management

Electives (Choose 3):

42.224	Business Writing	69.282	Negotiations in Purchasing
69.201	Marketing Principles	90.240	Computer Applications and Purchasing
69.251	Personnel Management		

Academic Policies, Procedures and Services

The Division of Continuing Education at the University of Massachusetts Lowell has an open enrollment policy: anyone may enroll in our courses, while anyone with a high school diploma or equivalent may be admitted into a degree or certificate program. Students must be admitted into a degree program to be eligible for most financial aid.

This section of the catalog reviews policies and procedures for admission, transfer, and financial aid. In addition, it reviews academic guidelines for successfully completing a course, a certificate program, or a degree program. The end of this section outlines pertinent state and federal laws which protect a student's rights with respect to privacy, discrimination, harassment, and affirmative action.

Admissions Procedures into Certificate and Degree Programs

Students are welcome to register for credit or noncredit courses offered by the Division of Continuing Education. Students who wish to pursue a certificate, an associate's degree, or a bachelor's degree must apply for admission to a program through the Office of Continuing Education.

To be considered for acceptance into a certificate or degree program, students must hold a high school diploma or a Graduate Equivalency Diploma (GED). Continuing Education operates on a rolling admissions basis and each application is reviewed when the student's file is complete. Students must be admitted to a degree program in order to be eligible for most financial aid.

The following materials must be submitted for admission:

1. An application (available in the Office of Continuing Education)
2. Official transcripts of all college, university, or post-secondary schools attended, and course descriptions, and
3. Official transcript of high school records, or its equivalent (GED certificate) from applicants with no previous college/university experience

After the above information is filed in the Office of Continuing Education, a program coordinator will evaluate the academic records. Qualified students will receive an official letter of acceptance and a transfer credit evaluation sometime after submitting all necessary academic materials. A student who has not yet completed 18 credit hours in his/her degree program will be admitted on a provisional basis.

Academic counselors and program coordinators are available to answer questions regarding programs and the matriculation process. Appointments may be made by calling (508) 934-2480.

Declaration of a Major

Upon application, students are requested to declare a major. Academic counselors and program coordinators are available to help students in selecting a field of concentration. An early decision of a major by students will greatly facilitate the selection of appropriate prerequisite courses for major fields and accordingly will reduce the possibilities of time-consuming errors in judgment.

Non-Matriculation

Students who wish to register for classes but not be admitted into a certificate or degree program may do so provided they have the necessary prerequisites for the course. Credit will be awarded for the successful completion of such courses. If the student chooses to become a certificate or degree candidate, the applicability of such course(s) may be subject to other policies of the University and/or to specific program requirements. Enrollment in courses does not constitute admission to a certificate or degree program. In order to matriculate, students must complete the admission process as described above.

Summer Graduate Level Courses

Students who hold the baccalaureate degree or its equivalent may enroll for credit in the graduate level courses which are normally offered during our summer sessions. Unless already matriculated in a UMass Lowell graduate program, the student must submit a transcript showing conferral of a bachelor's degree or subsequent summer graduate registration may not be permitted. Additionally, such a student is not eligible to receive credit toward a degree unless she or he files a formal application and is then admitted as a matriculated student to the Graduate School. Upon admission, an Academic Petition form must be filed to have previously earned credits considered toward a graduate degree.

Transfer Students

Students may transfer academic credit completed at other accredited institutions of higher education toward a certificate, associate's degree, or bachelor's degree. (Only one course may be transferred into each certificate program.) Official transcripts must be sent to the Office of Continuing Education with the application.

Credit will be accepted if it is equivalent to University of Massachusetts Lowell instruction, if it is applicable to the intended program, and if the student has received a grade equivalent to a C (2.00 on a 4.00 scale) or better. No credit will be recognized for the grade of P unless the catalog of the transferring institution specifically states that P is equivalent to a final course grade of C (2.00 on a 4.00 scale). Quarter credits are recognized on a pro-rated basis of three quarter credits to two semester credits.

Grades of transferred courses will be recorded with the notation CR which designates that credit has been granted and will not be computed into a student's cumulative grade point average at the University of Massachusetts Lowell. Please note that all credits to be transferred must be identified at the time of application for transfer. The University reserves the right to deny credit for course work taken by the student prior to admission if it is identified and presented after transfer.

Residency requirements (refer to page 118) are also considered when transfer credit is being evaluated.

The Commonwealth Transfer Compact

The University maintains flexibility in the transfer of qualified students from community colleges of the Commonwealth of Massachusetts.

The revised Commonwealth Transfer Compact (1990) provides a process to facilitate the transfer of collegiate credits and to ensure the appropriate recognition of academic progress earned by students at a community college who wish to continue their education at a public college or university.

The sending institution is responsible for identifying the transcript of each student who is a candidate for transfer under this compact.

To complete the baccalaureate degree, a student who transfers with an associate degree under this compact may be required to take no more than 68 additional credits unless:

- a. the student changes his or her program upon entering the receiving institution; or
- b. the combination of additional general education requirements, if any, and the requirements of the student's major at the receiving institution total more than 68 credits

Under these circumstances, transfer students will be subject to the same requirements as students who began their undergraduate education at the baccalaureate institution.

Academic Policies and Procedures

In registering for courses and/or accepting admission into the University, each student assumes responsibility for knowledge of and compliance with the definitions, regulations, and procedures of the University pertaining to his or her student status as set forth in the appropriate University of Massachusetts Division of Continuing Education publications and catalog.

Students who have questions about the interpretation or application of University academic policy should consult with the Academic Counselors or the Program Coordinators.

General Requirements for Associate and Baccalaureate Degrees

University policy requires all degree candidates to comply with the following standards:

1. Mastery of at least one discipline, field of knowledge or applied professional area;
2. Competence in writing the English language;
3. An understanding of the humanities, social sciences, mathematics, and science; and
4. A familiarity with problems and issues of value and choice.

All baccalaureate candidates are required to earn a 2.00 (C) cumulative average in their total course of study, to complete a minimum of 120 semester hours of course credits, to fulfill the residency requirements, to conform to the general regulations and requirements of the University, to satisfy the regulations and academic standards of the colleges which exercise jurisdiction over the degrees for which they are matriculating, to satisfy the curriculum requirements established by the departments or programs in their major, and to complete the University core requirements.

All associate degree candidates entering the University in 1994 are required to earn a 2.00 (C) cumulative average, to complete a minimum of 60 semester hours, to fulfill the residency requirements, to conform to the general regulations and requirements of the University, to satisfy the regulations and academic standards of the colleges which exercise jurisdiction over the degrees for which they are matriculating, to satisfy the curriculum requirements established by the departments or programs in their major, and to complete the University core requirements.

General Requirements for Certificates

All certificate candidates are required to earn a 2.00 (C) cumulative average in their total course of study, to complete the requisite number of course credits, to conform to the general regulations and requirements of the University, and to satisfy the regulations and academic standards of the colleges which exercise jurisdiction over the certificates for which they are matriculating.

Residency Requirements

Residency Requirements for Baccalaureate Degrees

In addition to satisfying specific course and achievement requirements, each baccalaureate candidate must complete at least 15 semester credits in regular course work within the major department of the University for each major which is presented for a degree with a 30 semester credit minimum completed at the University. This 30 semester credit minimum may include established course equivalency procedures and authorized day courses in the University.

Each candidate for a baccalaureate degree must also satisfy one of the following residency requirements:

1. Complete an associate's degree under the provisions of the Massachusetts Transfer Compact at a Massachusetts Community College, earning not more than 60 semester credits, and the remainder in courses at the University, earning not less than 60 semester credits.
2. Complete up to the first two years in an accredited two-year institution earning not more than 60 semester credits with grades of C (2.00 on a 4.00 scale) or better, and the remainder in courses at the University, earning not less than 60 semester credits.

3. Complete the equivalent of the first three years of a baccalaureate program in an accredited four-year institution, earning not more than 90 semester credits (C grades or better) and the remaining courses at the University, earning not less than 30 semester credits.
4. Complete 90 or more semester credits at the University and complete the remainder of the prescribed course of study at another accredited institution, earning not more than 30 semester credits at that institution.

Residency Requirement for Major Fields

Each baccalaureate degree candidate must complete at least 15 credits of course work in their major at the University of Massachusetts Lowell for each major which is presented for a degree.

Residency Requirements for Associate Degrees

In addition to meeting all the course requirements of an associate's degree, candidates must adhere to the following residency requirements:

1. Each student must complete at least 9 semester credits in regular coursework in his/her major department and must complete at least 24 semester credits through the Division of Continuing Education at UMass Lowell.
2. A student may pursue an additional associate's degree under the same regulations set forth for pursuing an additional baccalaureate degree (see page 119) except that the total number of credits to satisfy the residency requirement is 24.

Guidelines for Additional Baccalaureate Degrees

A student who has already earned a baccalaureate degree may be admitted to the University to pursue an additional baccalaureate degree in accordance with the following:

1. The nomenclature of the additional degree to be pursued must be distinctly different from the previously conferred degree (e.g. Bachelor of Arts, Bachelor of Science, etc.);
2. The major field of the previous degree must be clearly distinct from that of the additional degree;
3. The work for the additional degree must include the Continuing Education residency requirements;
4. The final 30 credits presented for the additional degree must be in addition to and independent of any previous baccalaureate;
5. A minimum of 15 credits must be taken at the University in the major field which is presented for the additional degree; and
6. A minimum of 30 semester credits must be completed at the University.

University Core Requirements

The University core requirements consist of the following:

A. English Composition Requirement (6 semester credits)

All students must pass a sequence of two courses totaling six semester credits in composition: 42.101 College Writing I & 42.102 College Writing II.

B. Area Distribution Requirements (27-29 semester credits)

All students must pass a minimum of nine courses (a total of 27 to 29 semester credits) in the area distribution requirements. A student whose academic major falls in a discipline listed under Area I, II, or III, or whose professional major is related to one of these disciplines, is exempted from the distribution requirements for courses in that area. However, students whose primary or secondary majors are in disciplines of the humanities and social sciences are required to complete area distribution requirements as specified and no exemption, in whole or in part, is permitted. In fulfilling the core requirements, a student is limited to a maximum of two courses in any one department. Additionally, a student is limited to two courses in literature. Pass/no-credit courses may not be counted toward the completion of the area distribution requirements.

Area I: Behavioral and Social Sciences: Economics, Geography, Political Science, Psychology, and Sociology.

Area II: Fine Arts and Humanities: Art, English (excluding 42.101, 42.102, 42.103, 42.104), History, Languages, Music, and Philosophy.

Area III: Mathematics and Sciences: Astronomy, Biology, Chemistry, Earth Sciences (Geology, Meteorology), Mathematics, and Physics.

General Implementation Policy

The following core distribution requirements are in effect for the Division of Continuing Education students. Please note that this is an all-inclusive list of approved University core courses and that not all University core courses are offered through Continuing Education.

1. Areas I and II (18 semester credits)

A minimum of two courses (six semester credits) must be completed in each of Area I and Area II, plus two additional courses (six semester credits) selected from either or both of these areas. Total to satisfy this requirement is six courses or 18 semester hours. (In fulfilling these distribution requirements, students are limited to a maximum of two courses in any one department, and irrespective of departmental listing, are limited to two courses in literature.)

Area I: Behavioral & Social Sciences

30.306	Introduction to Gerontology	48.101	Introduction to Sociology
40.248	Values in American Culture	48.110	Introduction to Social Values
41.261	Introduction to Legal Concepts	48.131	Sociology Through Literature
46.101	Introduction to American Politics	48.201	Social Anthropology
46.105	Science and Public Policy	48.214	Peace Making Alternatives
46.110	Introduction to Politics	48.231	Sociology of the Family
46.112	Comparative Political Systems	48.234	The Study of Minorities
46.121	Introduction to International Relations	48.241	Women in Society
46.131	Introduction to Political Thought	48.260	Sociology of Mass Media
46.240	Contemporary Political Theory	48.314	Nuclear Weapons, Values & Society
46.245	American Constitutional Development	48.316	Sociology of the Middle East
46.307	American Political Thought	48.341	Social Stratification
46.320	Women and Politics	48.361	Sociology of Law and the Criminal Justice System
46.357	Environmental Policy	48.382	Social Movements
46.360	Comparative European Politics	49.101	Gov. & Mkts: U.S. Economy
46.368	Middle East in the Modern World	49.200	Economic Analysis
47.101	General Psychology	49.201	Economics I (Microeconomics)
47.209	Social Psychology	49.202	Economics II (Macroeconomics)
47.232	Psychology of Personality	49.307	Government & Business
47.255	Community Psychology	49.310	Economics of Less Developed Countries
47.260	Human Development I	49.403	International Trade Theory
47.272	Abnormal Psychology	49.405	Japan's Economic System
47.276	Theories of Learning	59.203	Technology & Human Values I
47.277	Sensation and Perception	59.204	Technology & Human Values II
47.278	Cognitive Psychology	59.305	Contemporary Japanese Society
47.328	Dynamics of Interpersonal Relations	59.309	The Engineer in Society
47.335	Psychology of Women	59.321	Literature of Technology and Human Values
47.364	Psychology of Crime and Corrections	59.395	Computers in Society
47.388	Human Factors in Design & Engineering	88.101	World & Regional Geography
		88.126	Geography of the US & Canada

Area II: Fine Arts & Humanities

42.201	Great Books of Antiquity	45.201	Introduction to Philosophy
42.202	Great Books of the Modern Period	45.202	Introduction to Logic
42.210	Drama	45.203	Introduction to Ethics
42.211	Poetry	45.204	Logic & Language
42.212	The Short Story	45.206	Political Philosophy
42.217	The Horror Story	45.216	Plato & Beginnings of Philosophy
42.218	Comedy	45.284	Philosophy of Art & Beauty
42.234	Modern Fiction and the Future	45.301	Theory of Knowledge
42.245	Literature on Technology and Human Values	45.303	Philosophy and Technology
42.255	Aging, Illness & Death in Literature	45.305	Language Signs & Symbols
42.267	Introduction to Shakespeare	45.312	Philosophy of Science
42.270	Contemporary American Fiction	45.315-325	Philosophical Classics
42.271	Oriental Literature in Translation	45.326	Ethics and Business
42.274	Literature of the Beat Movement	45.332	Cognitive Sources of Conflict
42.291	History of English Literature I	45.333	Symbols & Society
42.292	History of English Literature II	45.334	Engineering and Ethics
42.294	History of American Literature I	45.335	Ethical Issues in Technology
42.295	History of American Literature II	45.354	Classical Rhetoric and Theory of Argumentation
42.307	History & Development of the English Language		
42.308	Analysis of Modern English		
42.317	British Literature of the 20th Century	50.211*	Intermediate Conversational French I
42.345	Female English Novelists	50.212*	Intermediate Conversational French II
42.356	Literature of the Victorian Period	50.221	Reading & Conversing in French I
42.370	Contemporary American Fiction	50.222	Reading & Conversing in French II
42.382	Crime in Literature		
		51.211*	Intermediate German I
		51.212*	Intermediate German II
43.101	Classical Civilization		
43.105	Western Civilization to 1715	52.211*	Intermediate Italian I
43.106	The Modern World	52.212*	Intermediate Italian II
43.111	U. S. History to 1877	52.325	Italian American Literature and Culture
43.112	U. S. History Since 1877	52.371	Dante's Divine Comedy
43.202	Science and the Modern World	52.373	Italian Humanism
43.206	American Economic History	52.378	Italian Cinema & Culture
43.210	History of American Popular Culture		
43.216	American Urban History I	54.211*	Intermediate Conversational Spanish I
43.217	American Urban History II	54.212*	Intermediate Conversational Spanish II
43.237	Europe in the Twentieth Century	54.221	Reading & Conversing in Spanish I
43.242	The Second World War	54.222	Reading & Conversing in Spanish II
43.270	Women in American History	54.310	Spanish Civilization and Culture
43.272	The American Indian		
43.273	American Indians and the U.S.		
43.302	Byzantine History and Civilization	59.205	Human Values in Western Culture I
43.308	History of Crime Conflict & Control	59.206	Human Values in Western Culture II
43.350	Colonial America: History & Culture	59.208	Western Cultural Heritage I
43.352	Coming of the American Revolution	59.209	Western Cultural Heritage II
43.353	American Revolution & Beginnings of Const. Govt.	59.303	Understanding Technological Risk
		59.306	The Social Impact of Evolution
43.362	The 20s and the 30s	59.314	Society & Culture in the Early Middle Ages
43.363	Recent U. S. History: 1940 to Present	59.315	Islam & Medieval Europe
43.364	War and Cold War: U. S. History in the 1940's and 1950's	59.321	Literature of Technology and Human Values
43.365	U. S. History Since 1960		
43.369	Russia in the 19th and 20th Centuries	70.251	Visual Design I
43.383	Technology and American Culture	70.253	Three Dimensional Design Studio
43.393	History of the Middle East	70.255	Drawing I

(continues...)

71.110	Basic Music Theory	79.101	Art Appreciation
74.101	European Musical Culture - Middle Ages	79.203	Survey of Art I: Prehistoric to Medieval Art
74.161	Music of Western Civilization	79.204	Survey of Art II: Renaissance to Modern Art
74.163	Development of Jazz	79.231	Greek & Roman Art
74.166	Women in Music	79.321	Italian Renaissance Art
74.201	Musical Life in America before 1900	79.323	Northern Renaissance Art
		79.331	Italian Baroque Art
		79.334	Northern Baroque Art

*Credit is not given for only one semester of beginning or intermediate language courses. These courses must be taken for two (preferably consecutive) semesters.

2. Area III (9-11 semester credits)

A student must also complete a minimum of three courses (nine to eleven semester credits) in Area III. One course must be in a laboratory science, a second course must be in mathematics, and a third course must be in science or mathematics. Students who wish to satisfy the core requirement for a laboratory science must register for the corequisite laboratory wherever applicable. If a student elects to take a science without the laboratory component, it will not satisfy that part of the University core requirement of one laboratory science course. The total required to satisfy this requirement is three courses or nine to eleven semester credits.

Area III: Mathematics & Science

Laboratory Science Courses

83.101	Life Science I (Corequisite 83.103)
83.102	Life Science II (Corequisite 83.104)
83.103	Life Science Laboratory I (Corequisite 83.101)
83.104	Life Science Laboratory II (Corequisite 83.102)
83.122	The Plant & You: Humanistic Botany
83.128	The Microbial Perspective (Corequisite 83.129)
83.129	The Microbial Perspective: Laboratory (Corequisite 83.128)
84.101	Applied Chemistry for the Non-Scientist
87.103	Earth & Its Environment I (Corequisite 87.105)
87.104	Earth & Its Environment II (Corequisite 87.106)
87.105	Earth & Its Environment I Laboratory (Corequisite 87.103)
87.106	Earth & Its Environment II Laboratory (Corequisite 87.104)
87.115	Astronomy I (Corequisite 87.117)
87.117	Astronomy Laboratory (Corequisite 87.115)
89.101	General Geology I (Corequisite 89.103)
89.102	General Geology II (Corequisite 89.104)
89.103	General Geology I Laboratory (Corequisite 89.101)

89.104	General Geology II Laboratory (Corequisite 89.102)
89.111	Introduction to the Oceans
95.121	Exploring the Universe (Corequisite 96.121)
96.121	Exploring the Universe Lab (Corequisite 95.121)
99.101	Radiation & Life (Corequisite 99.102)
99.102	Radiation & Life Lab (Corequisite 99.101)

Non-Laboratory Science Courses

83.123	Nutrition & Disease
83.126	Human Disease & Immunity
83.214	Human Ecology

84.115	Chemistry in Art
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93.141	Weather and Climate
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Mathematics Courses

92.110	College Algebra
92.111	Mathematical Perspectives
92.121	Precalculus Mathematics
92.122	Differential Calculus
92.183	Introduction to Statistics
92.201	Integral Calculus
92.203	Mathematics of Music
92.265	Pascal Programming

3. Human Values Requirement (3 semester credits)

All students are required to pass one Human Values course which emphasizes the values and processes that lead to the making of ethical and humane decisions. Except for courses designed by departments or programs to meet this requirement and which shall be required for and restricted to majors only, a student shall satisfy this requirement by passing a course selected from an approved list. Several courses which appear on this listing also appear on listings for area distribution requirements. These courses may satisfy both requirements, as noted. However, the credits for such courses may not be double counted for the total credits presented for degrees.

Human Values Requirement

01.323	Moral Problems in Medicine	47.209	Social Psychology
40.248	Values in American Culture	47.335	Psychology of Women
41.365	Law and Society	48.110	Introduction to Social Values
42.253	Culture of Sports	48.131	Sociology Through Literature
43.393	History of the Middle East	48.201	Social Anthropology
45.201	Introduction to Philosophy	48.215	Peacemaking Alternatives
45.203	Introduction to Ethics	48.234	The Study of Minorities in the U.S.
45.206	Introduction to Political Philosophy	48.241	Women in Society
45.281	Symbols & Society	48.260	Sociology of Mass Media
45.284	Philosophy of Art & Beauty	48.314	Nuclear Weapons, Values & Society
45.303	Philosophy & Technology	48.382	Social Movements
45.326	Ethics and Business	49.307	Government & Business (College of Management Majors only)
45.334	Engineering and Ethics	52.378	Italian Cinema & Culture
45.335	Ethical Issues in Technology	59.203	Technology & Human Values I
46.131	Introduction to Political Thought	59.204	Technology & Human Values II
46.240	Contemporary Political Theory	59.205	Human Values in Western Culture I
46.307	American Political Thought	59.206	Human Values in Western Culture II
46.310	Contemporary Political Thought	59.303	Understanding Technological Risk
46.320	Women, Power and Politics	59.309	Engineer in Society
46.333	Technology & Gender	59.321	Literature of Technology and Human Values
46.367	American Environmental Policy	59.395	Computers in Society
		87.102	Conservation & Environmental Concern

Grading Information

The following qualitative letter grades are employed by faculty members to characterize the quality of a student's work in a course: A, AB, B, BC, C, CD, D, and F which respectively carry quality points of 4.000, 3.500, 3.000, 2.500, 2.000, 1.500, 1.000 and 0.

- A Designates that the work done by the student is superior and is of the highest honors quality;
- AB Designates that the work done by the student is less than superior but is completed with a level of distinction which is higher than the basic honors level;
- B Designates that the work done by the student is of basic honors quality;
- BC Designates that the work done by the student is less than honors quality but is better than satisfactory;
- C Indicates satisfactory work which conforms to the general expectations of the University for baccalaureate, associate and certificate study;
- CD Indicates that the work done by the student is less than satisfactory and below graduation standards but is better than the minimum requirement for passing a course;
- D Indicates work which meets the minimum requirement for passing a course;
- F Designates course failure

In addition to the above letter grades, the following symbols are also used to designate special enrollment provisions or course statuses and do not affect the student's academic average:

- P Designates completion with credit of an unrestricted elective which was taken on a pass-no credit basis.
- NC Indicates failure of an unrestricted elective which was taken on a pass-no credit basis;
- S Designates satisfactory completion of a practicum experience course with a grade of C or higher;
- U Designates unsatisfactory performance in a practicum experience course with a final course grade of less than C;
- I Indicates a course which has not been completed;
- W Designates official withdrawal from a course within the established deadline;
- X Designates withdrawal after the established deadline for administratively approved reasons for an emergency or medical nature;
- Y Designates administrative withdrawal for other than academic reasons;

A student may be administratively dismissed from the University through cancellation of registration for due cause, through suspension or expulsion for academic dishonesty, and through disciplinary procedures for violations of good conduct.

Administrative dismissal may be invoked when a student fails to comply, after due notice, with an administrative regulation of the University. Official notification of an administrative dismissal is noted on the permanent record card by the symbol Y, which is entered for each course which has been carried by the dismissed student. Reinstatement of a student who has been administratively dismissed may be made only by application for readmission with the Division of Continuing Education and only when the condition which has necessitated administrative dismissal can be ameliorated to the satisfaction of the University officials. Examples of some conditions which may justify administrative dismissal are as follows:

- a. Forgery or fraudulent use of University records, documents, or forms; unauthorized entry into University records (including computerized records);
- b. Non-payment of tuition, student fees, library fines, overdue University loans, and other official University fiscal obligations;

- c. Failure to comply with a duly authorized administrative order relating to the safety of persons or the protection of University property;
- d. Failure to withdraw from the University after certification of a physical health or mental health condition of a hazardous nature.

AU designates that the student has registered for a course on an audit basis and has maintained an attendance record throughout the semester which is sufficient to warrant an official recognition of course attendance. Credit may not be earned in courses which have been audited except by re-enrollment in and completion of the course with a passing grade. Students who have audited a course subsequently may not earn credit in the same course through tests of the College Level Examination Program or through other authorized examination procedures for course challenge. The fee for audit is full tuition.

Withdrawal

W notation is not an academic grade but a symbol designating official withdrawal from a course within the established deadline of the eighth class meeting of a semester. Official withdrawal is accomplished by filing a withdrawal form in the Office of Enrollment Services.

A notation of W cannot be given for unofficial withdrawal from a course or for unofficial withdrawal from the University. Accordingly, a student who registers for a course and is carried on an official class roster after the eighth class meeting of a semester must be graded in terms of the completion of the instructor's total course requirements even though the student did not attend any class meeting or unofficially left the University before the eighth week of the semester. A student who wishes to withdraw from a course after the deadline of the eighth class meeting must submit a petition to the Office of Enrollment Services. An X will be given only when it can be demonstrated that extended illness or a critical personal emergency of an extended nature prevented that student from complying with official withdrawal procedures. Students receiving benefits from the Veterans Administration are not eligible for retroactive withdrawal from courses.

Incomplete Courses

The letter symbol I (incomplete) is a temporary notation which is assigned for incomplete work in courses when the records of students justify the expectation that they will obtain a passing grade but for emergency reasons they have been absent from the final course evaluation. Any missed final examination or other final course evaluation requires a student explanation within 48 hours so that the instructor can file the proper course notation with the Office of Enrollment Services. A student who has evidenced an unsatisfactory course record, who has failed to complete a major portion of an instructor's course requirements, or who fails to provide an instructor with a satisfactory reason for absence from a final examination or final course evaluation within the specified 48 hour period may not be assigned the letter symbol I. Responsibility for making arrangements with an instructor to complete all outstanding course work rests entirely with the student, who must complete all course work in sufficient time to permit an instructor to file a final course grade no later than one month after the date on which the succeeding semester begins.

Whenever possible, the student and instructor should sign the permission for an Incomplete Form.

Please note that make-up final examinations administered by the Division of Continuing Education through the Office of Enrollment Services are done so only on specific dates. The instructor is responsible for administering the make-up final examination if the student does not take the exam on the specified make-up dates.

Instructors who file letter symbols of I also must file an end-of-course letter grade which will be assigned in the event that incomplete course work is not made up by the student prior to the established deadline. At the end of the official make-up period (or, in the event of a substantiated student emergency, at the end of an extended make-up period), the Division of Continuing Education will convert the temporary notation of I to the appropriate permanent symbol. This permanent notation will be one of the following: 1) a letter grade which has been filed by an instructor during the grading period of the previous semester to designate the final course standing of a student who has failed to make up incomplete course requirements, 2) a letter grade which is filed by an instructor at the end of the make-up period to designate the final course standing of a student who has made up incomplete course requirements, or 3) the letter symbol of X that must be approved to designate that a student has withdrawn from the University after the end of the semester for documented medical or personal emergency.

Limited extensions of the make-up period may be granted to students for serious medical reasons and for documented personal emergencies. Requests for such extensions must be approved and must be filed no later than one calendar week preceding the established deadline for instructors to submit final grades for incomplete courses. Except for extraordinary circumstances the maximum period for which an extension may be granted is the last scheduled class day of the semester following the assignment of I notations.

Record Cards (Transcripts) and Reporting of Grades

Grade reports are mailed by the Office of Enrollment Services to the address listed on the student's registration form as soon as possible after the end of each semester. University policy does not allow grades to be given over the phone. Students may file for official transcripts by completing the written form available in the Office of Enrollment Services. All transcripts are \$1.00.

The University of Massachusetts Lowell will create and maintain a permanent record card (transcript) showing complete course and grade-earned information for any student, matriculated or non-matriculated, who takes a course for credit. This record may not be modified or selectively deleted for any reason including the student's lack of awareness of the drop and withdrawal deadlines cited in our semester bulletins.

Grade Changes

At the end of each semester, the Office of Enrollment Services mails a grade report to each student. This report constitutes official notification of grades received. All course grades become a part of the student's official record upon instructor assignment and may not be changed except as specifically provided by University procedures. Corrections of grade-point averages automatically are authorized when erroneous grade reports are corrected by instructors and when specific courses are deleted from grade-point averages under provisions of University regulations governing repeated failed courses, change of enrollment status as an intercollegiate transfer within the University, and expiration of degree credits.

Students who believe that a mistake has been made in assigning or recording a course grade should notify instructors as soon as possible after receiving their grade reports but in no case at a time later than the deadline established for making grade corrections. The deadline for instructors to correct an erroneous grade report is one calendar month from the beginning of the semester following the filing of an erroneous grade. Changes of grades other than the filing of grades for incomplete courses require endorsement from the Office of Enrollment Services. Grade changes may not be made on a student's permanent record card after the deadlines cited above unless such changes have been authorized prior to the expiration of the correction deadline.

Repeated Coursework

Any failed course which is a prerequisite for another must be repeated and passed before the student can take the advanced course.

Students may repeat a limited number of courses in which they received a grade of F and have the repeated grade substituted for the original grade in the computation of the cumulative grade-point average. Non-probationary students must repeat courses within 30 semester hours (equivalent to 2 semesters of full-time study) following their course failures. Although probationary students may not invoke the grade substitution provision during their periods of probation, they may invoke the grade-substitution process upon removal from probation. Students transferring with less than 60 semester credits are permitted a maximum of 11 credits of course repetition for grade substitution; students transferring with 60 or more semester credits are permitted a maximum of 7 credits of course repetition for grade substitution. Students must designate by petition which courses are being repeated for the purpose of grade substitution before re-enrolling.

Prior to an initial determination of academic progress, a student may not repeat courses for grade substitution. Students may repeat a passed course within the provisions of the grade substitution rule cited above; however, if the grade of the repeated course is less than the original grade, both grades will be used in computing the grade point average.

Course Equivalency Examinations

Subject to specified policies of academic departments, qualified degree candidates are given the opportunity to demonstrate their special competencies and to receive University credit for such competencies through established course equivalency procedures without having to fulfill classroom or faculty course requirements. The University recognizes two types of course equivalency for which credit is awarded.

These are:

1. **College Level Examination Program (CLEP)**, is a national program of credit-by-examination that offers the opportunity to obtain recognition for college level achievement, no matter when, where, or how learning has been acquired. These examinations can be taken in general subject areas or in specific subject areas. If the results of the examination(s) are acceptable to University guidelines, college credit is given toward an undergraduate degree.

Please note that the College of Arts and Sciences does not recognize and will not award credit for CLEP tests in a foreign language offered to satisfy the language proficiency requirement.

2. Departmental Examinations

Students interested in taking departmental examinations must first arrange an interview with the appropriate coordinator, at which time they must present evidence that they possess sufficient competency to warrant a departmental examination. Departmental examinations will not be given if a corresponding CLEP examination is available. Departments also reserve the right to refuse the granting of credit by examination for those courses which are presented by students for their major. When written permission is given to a student to take a departmental examination, the conditions of the examination will be set forth. Typically, the examination must be wholly or substantially written unless the nature of the course makes more appropriate an oral or performance examination. Students may be asked to take end-of semester examinations which are scheduled during the final examination period when such examinations are adequate measures of total course requirements. A \$40 fee must be paid after the departmental exam form is signed by the coordinator and the student, and before the student takes the examination.

Students may not repeat departmental equivalency examinations and, except for documented medical reasons or personal emergencies, they may not reapply for such examinations in the event that they fail to keep an examination appointment.

Students may not receive credit for a specific proficiency examination:

1. If they have registered at the University in the course which that examination represents,
2. If they have previously received a University grade for that course or a course in sequence above the course for which they wish to take the examination,
3. If they have previously attempted an equivalent course at another institution and,
4. If a general examination is related to the student's academic major.

Baccalaureate degree students may apply for course equivalency credits up to a maximum of 30 credits; however, the total number of equivalency and transfer credits may not exceed 90 credits for the baccalaureate degree. Nor may transfer students present equivalency credits in fulfillment of the major field residency requirement of 15 credits in University courses or the general residency requirement of 30 credits.

Directed Study

A directed study is ordinarily an alternative arrangement for enrolling in an advanced course not being offered during a particular semester. It allows the student to meet on a regular basis with an instructor who is willing to undertake the course. The student must complete the Request for Directed Study form which lists the course, meeting dates, assignments, papers, or projects to be completed, and the form should be signed by the instructor and coordinator before the student can register. Students enrolled in the day school must also obtain approval from the Dean of the College before they can register for directed study.

Because directed studies are considered Special Programs, tuition remission and certificates of eligibility cannot be used.

Instructor Course Requirements

At the first class meeting, instructors must distribute a written statement of requirements for each course to all students and to the Division of Continuing Education. This statement must include a specification of the number and types of course evaluations to be employed throughout the semester (including the dates of the examinations), special requirements for completing assignments and taking examinations, and a definition of course attendance policy. Normally, a minimum of three evaluations of student progress (written or oral examinations, written reports, recitations, laboratory techniques and reports, jury or performance evaluations) should be made in each course, at least one evaluation being required during each half semester. Upon the request of a student, an instructor is required to provide a statement of the student's course progress. Prior to the last date for withdrawing from courses, students who are in danger of receiving D or F grades either shall be so notified by the instructor or shall be in possession of such course evaluations as will permit such students to reasonably infer their course progress and academic jeopardy.

Course Examination Policies

Final examinations are required for all undergraduate courses. Final examinations may not be given at a place or time other than those which have been specified. Final take-home examinations may be submitted to instructors during the final examination period on the day and at the time scheduled.

Make-up examinations irrespective of make-up final examinations administered on specific dates by the Division of Continuing Education through the Office of Enrollment Services are the responsibility of the instructor.

Class Standing	Freshman Standing	0-29 credit hours
	Sophomore Standing	30-59 credit hours
	Junior Standing	60-89 credit hours
	Senior Standing	90 credits or more

Size of Class

Courses are only offered if enrollment is sufficient. Consequently, to ensure the scheduling of desired courses, students are urged to take advantage of the early registration policies as scheduled in each semester bulletin of class listings.

In the event that a course is cancelled, the Office of Enrollment Services will try to notify preregistered students. Students may elect to enroll in another course or may request a full refund.

Attendance

Students must attend 80 percent of all classes held in their courses. More than three unexplained absences may cause a student to be dropped from the class enrollments with a grade of F in the course. Examinations or other work missed by absence may, at the option of the instructor, be made up or failed (except for provisions provided by absences due to religious reasons).

Class Schedule

Fall and spring semesters

Classes in the Division of Continuing Education undergraduate degree programs are scheduled from 6:00 p.m. to 9:00 p.m. or 7:00 to 10:00 p.m. on Monday, Tuesday, Wednesday and Thursday evenings as listed in each semester tabloid. Saturday classes are also offered from 9:00 a.m. to 12 noon during the academic year.

Winter Intersession

Intersession courses are offered during the month of January, prior to the start of Spring classes for students who want to accelerate their educational program. Day classes are held from 9:00 a.m. to 12:30 p.m., Monday through Saturday; Evening classes are held from 6:00 p.m. to 9:30 p.m., Monday through Friday and 1:00 p.m. to 4:30 p.m. on Saturday.

Summer Sessions I and II

Graduate and undergraduate summer day classes are scheduled four days a week (for 3-credit classes) and five days a week (for 4-credit classes) for a period of six weeks. Summer evening classes are scheduled two evenings a week; Monday and Wednesday, or Tuesday and Thursday from 7:00 p.m. to 10:00 p.m. (with a few Friday evening classes) for a period of six weeks.

For the latest information on course offerings, scheduling, and tuition, call the Office of Enrollment Services at (508) 934-2480 for a copy of the Fall, Winter, Spring, or Summer Continuing Education Course Bulletins.

Academic Standing

Academic standing and eligibility for a degree are determined by the quality of the student's course work.

Determination of Academic Standing

To ascertain the student's academic standing, the University uses a point system, each qualitative grade having an equivalent numerical value.

A	=	4.000	C	=	2.000
AB	=	3.500	CD	=	1.500
B	=	3.000	D	=	1.000
BC	=	2.500	F	=	0.000

Quality points are computed by multiplying the number of course credits by the numerical value of the qualitative grade assigned. For instance, a three-credit course with a grade of BC would carry 7.500 quality points (3×2.500). Grade-point averages and cumulative grade-point averages are obtained by dividing the number of quality points earned by the number of quality hours attempted.

Specified grade-point averages are computed solely on the basis of those courses attempted at the University of Massachusetts Lowell which have been qualitatively evaluated with the following letter grades: A, AB, B, BC, C, CD, D, and F.

All students are required to maintain at least a 2.000 average throughout their academic career. Academic records are evaluated at the end of each semester. No student, however, will be academically suspended without having at least one semester of academic notice or warning. The academic status of a student is one of the following six categories:

Satisfactory Academic Standing

Indicates that the semester grade-point average is at least 2.000, and the cumulative grade-point average is at least 2.000.

Academic Notice

Indicates that: a) the semester grade-point average is less than 2.000 but the cumulative grade-point average is at least 2.000; or b) a "low-credit student" (one who has attempted fewer than 21 credit hours) has a cumulative grade-point average of at least 1.700 but less than 2.000.

Academic Alert

Indicates that a low-credit student (one who has attempted fewer than 21 degree credits) has a cumulative grade-point average below 1.700.

Academic Warning

Indicates either: a) the cumulative grade-point average is below 2.000; or b) the semester grade-point average is below 2.000 but the cumulative grade-point average is at least 2.000, and the student had been on Academic Notice, Alert, or Warning at the end of the previous semester.

Academic Suspension

Indicates that the student was on academic notice or warning at the end of the previous semester and the cumulative grade-point average is below 2.000.

Academic Probation

Indicates that the student was readmitted after an academic suspension.

Academic Dismissal

Indicates that a student was on academic probation and failed to achieve satisfactory academic standing during the probationary semester.

Changes in Academic Standing

1. A student who has been in satisfactory academic standing and whose semester grade-point average is less than 2.000 but whose cumulative grade-point average is at least 2.000 is placed on academic notice. A student who has been in satisfactory academic standing and whose semester grade-point average is less than 2.000 and whose cumulative grade-point average is less than 2.000 is placed on academic warning.

2. A low-credit student whose cumulative grade-point average is at least 1.700 but below 2.000 will be placed on academic notice.

3. A student who has been on academic notice or academic warning:

- If the student's semester grade-point average and cumulative grade-point average are at least 2.000, the student will be in satisfactory academic standing.
- If the student's semester grade-point average is at least 2.000 but cumulative grade-point average is less than 2.000, the student will be academically suspended.
- If the student's semester grade-point average is less than 2.000 but cumulative grade-point average is at least 2.000, the student will be placed on academic warning.
- If the student's semester grade-point average and cumulative grade-point average are both below 2.000, the student will be academically suspended.

4. A student who has been re-admitted on academic probation but who does not satisfy the requirements of probation at the end of the probationary term is academically dismissed from the University. (See "Academic Probation" on the next page.)

Appeal of Suspension

Suspension may be appealed if and only if:

- a. the student has attempted at least 21 but less than 35 credit hours* and has a cumulative grade-point average greater than 1.700; or
- b. the student has attempted at least 35 but less than 69 credit hours* and has a cumulative grade-point average greater than 1.800; or
- c. the student has attempted at least 69 credit hours* and has a cumulative grade-point average greater than 1.900.

*Included in course hours attempted are all course credits which have been granted (including credits awarded through transfer and challenge by examination, course credits which have been awarded with qualitative letter grades, and credits attempted with notation of "Incomplete" or with nonqualitative grades of P and S) and all hours of course work which have been failed with the qualitative letter grade of F.

If eligible for appeal, a suspended student may submit a written appeal to the Academic Standards Committee requesting permission to continue enrollment in an additional semester of academic warning. The

written appeal must include a proposed program of study for the following semester, approved by the student's program coordinator. The student will be notified in writing of the Committee's decision. If permission to continue is granted, the program of study that must be undertaken and the minimum semester grade-point average that must be attained during the additional semester of academic warning will be detailed.

Retention Requirements for Students who entered the University prior to the Fall 1992

Each student is subject to the following table of grade-point requirements for the specified numbers of attempted course hours. The cited grade-point averages are minimum University requirements. Individual colleges/departments may establish higher standards.

Grade-Point Course Hours Attempted*	Grade-Point Averages for Satisfactory Standing	Grade-Point Averages for Academic Warning	Grade-Point Averages for Academic Suspension
12-30	1.500	1.400-1.499	1.399 or below
31-45	1.600	1.500-1.599	1.499 or below
46-60	1.700	1.600-1.699	1.599 or below
61-75	1.800	1.700-1.799	1.699 or below
76-90	1.900	1.800-1.899	1.799 or below
91-Graduation	2.000	1.900-1.999	1.899 or below

* Included in "Course Hours Attempted" are all course credits which have been granted (including credits awarded through transfer and challenge by examination, course credits which have been awarded with qualitative letter grades, and credits attempted with notations of "Incomplete" or non-qualitative "P" and "S" grades) and all hours of course work which have been failed with the qualitative letter grade of "F".

Specified grade-point averages are computed solely on the basis of those courses completed at the University of Massachusetts Lowell or through University auspices under previous policies which governed authorized off-campus study and which were qualitatively evaluated with the following letter grades: A, AB, B, BC, C, CD, D, and F.

At the end of each official grading period, the University automatically evaluates the cumulative averages of all matriculating students for compliance with University retention standards. Students whose cumulative grade-point averages are below retention requirements at the end of any official grading period have not made satisfactory academic progress and are so notified on their computerized grade report. Students whose cumulative grade-point averages fall below the requirements for their attempted course credits by more than 0.10 are immediately suspended. Students whose cumulative grade-point averages are not more than 0.10 below the requirements for their attempted course credits are placed on academic warning. Students who have been placed on academic warning must achieve satisfactory standing upon the completion of 18 additional hours of course work or they will be suspended from the University.

Academic Probation

A student who has been suspended from the University as a matriculating student in the Division Continuing Education is entitled to apply to the Division of Continuing Education for readmission as a probationary student in accordance with procedures enumerated under the policy heading Probationary Readmission (see next page). Students who are readmitted on probation will receive a letter from the appropriate Academic Standards Committee that specifies the academic average they must achieve during their probation to achieve satisfactory academic standing.

A student who achieves the required academic average during his or her probation is automatically reinstated in satisfactory academic standing. A student whose average falls below the requirement by no more than 0.10 may be granted an extension of the probation, permitting completion of an additional 18 credits. Such extension would be made by the appropriate Academic Standards Committee during the period between semesters. Students who are granted such extensions will be notified in writing prior to the beginning of classes for the following semester. Students who fail to satisfy probationary standards and are not granted extensions, and students who are granted such extensions and fail to achieve satisfactory academic standing by the end of the designated period are permanently dismissed from the University and are subsequently barred from attending both day and evening courses.

Students who have been readmitted on probation may not invoke University regulations which govern course repetition for the purpose of deleting course grades from cumulative averages. Nor may they withdraw from any course unless they withdraw from the University with permission for reasons of an emergency or medical nature. A probationary student who withdraws from any course without authorization cannot by definition satisfy the conditions of his or her probation and will be permanently dismissed from the University at the end of the current semester of enrollment.

Probationary students who receive course evaluations of I (incomplete) and who fail to make up their work under the regulations of an I grade are advised that they may not qualify for extension of their probation, may not register for nor attend University courses (including summer courses), and may not receive authorization to pursue off-campus studies until a final determination of their status has been made. Accordingly, probationary students are advised that they should not delay completion of course work until the make-up deadline which has been established for students in satisfactory academic standing unless they wish to postpone resumption of their studies. Students who have received permission to extend their make-up period are advised that such authorized extension does not waive the requirement for a final determination of academic standing which is based upon grades for all probationary courses.

Following the attainment of satisfactory academic standing and removal from probation, a student who has failed a course during the two semesters preceding suspension and has repeated and passed such a course during the probationary period may retroactively invoke the provision which permits deletion of the course failure from the cumulative grade-point average.

Probationary Readmission

A student who has been suspended from the University as a student in Continuing Education is entitled to apply for readmission as a probationary student but may not resume studies until after an absence from the University of one semester. Application for such readmission to all programs is made through the Office of Continuing Education in accordance with prescribed procedures and must be received by April 1 for readmission decision during the Fall Semester and by November 1 for readmission decision during the Spring Semester. Petitions which have been received by the filing deadline of November 1 will be reviewed by the Academic Standards Committee during the Fall Semester and readmitted students will be permitted to initiate their probationary studies at the beginning of the Spring Semester. Similarly, petitions which have been received by the filing deadline of April 1 will be reviewed by the Academic Standards Committee during the Spring Semester and readmitted students will be permitted to initiate their probationary studies at the beginning of the Fall Semester.

In determining such requirements for probation, the Academic Standards Committee shall prescribe a sufficient number of courses (18 credits) which shall make the achievement of satisfactory academic standing reasonably possible during the designated probationary period.

Suspended Day School Students

University of Massachusetts Lowell day school students who are on academic suspension may not take courses through Continuing Education unless they have received permission to do so. Suspended students who wish to transfer to Continuing Education must consult with an Academic Counselor prior to applying for readmission.

After securing recommendations from appropriate program coordinators and studying the previous academic record of the student, the Academic Standards Committee will set the conditions for probation (courses to be taken, conference schedules with the program coordinators, etc.).

Academic Dismissal

Students on academic probation who fail to achieve satisfactory standing during their probationary period and are not granted extensions of their probation by the appropriate academic standard committee and students who fail to achieve satisfactory academic standing are dismissed from the University and are subsequently barred from attending both day and evening courses. While on dismissal, students are not allowed to make any progress toward a University degree. Grades received by such students will not be credited to University programs even if the students are reinstated as probationary students or achieve satisfactory academic standing after reinstatement. The University recognizes that dismissal from the institution for reasons of academic failure need not be permanent. Under the following circumstances readmission is possible.

Students who have achieved the equivalent of freshman and sophomore standing and who have been academically dismissed may qualify for readmission to the University as follows: 1) under the provisions of the Massachusetts Transfer Compact after completion of an associate degree at a Massachusetts Community College; and 2) after a lapse of two years during which time they may have demonstrated their academic capacity and seriousness of purpose by obtaining an associate degree at a regionally accredited institution of higher education.

Students who have achieved the equivalent of junior or senior standing at the time of dismissal may reapply for readmission after an absence of at least two years if they have developed records of successful work or professional experience during this period which demonstrates their seriousness of purpose. Additionally, the grade point average at the time of dismissal must be sufficiently high to afford a reasonable chance of successful completion of their probationary period or their degree requirements.

Students who wish to be considered for readmission must petition the Division of Continuing Education. The Academic Standards Committee will determine whether the student will be readmitted on a probationary basis.

Graduation

Graduation Interview

Students anticipating graduation in the 1993-94, 1994-95 academic years must arrange for a graduation interview through the Office of Enrollment Services. The purpose of this interview is to determine eligibility for graduation and to begin the ordering process for the diploma. During this interview, degree candidates must identify such problems as missing courses or any problems with grades, incompletes, or transfer credits.

Students who expect to complete their degree requirements in the fall semester must complete the interview by the end of October and students who expect to complete their degree requirements in the spring semester or summer terms must complete their interview by mid-March, to ensure that their names are included in the graduation program and that their diplomas are available at graduation time. Appointments are made in person at the Office of Enrollment Services or by calling (508) 934-2480.

Commencement Fee

A fee of \$75.00 is required of graduating students and is payable on or before registration for the final semester in which the student qualifies for the degree. The fee covers the cost of the student's eligibility review, the diploma, invitations, and the cap and gown for the graduation ceremony. All students are required to pay the graduation fee regardless of attendance at the graduation ceremony.

Awarding of Degrees

The University awards degrees three times a year:

1. For students completing degree requirements during the spring semester, the degrees are awarded in June and diplomas are available to students in June;
2. For students completing degree requirements during the fall semester, the degrees are awarded in February and the diplomas are available to students in March; and
3. For students completing degree requirements during the summer term, the degrees are awarded in October and the diplomas are available to students in December.

Individuals who wish to submit verification of degree completion to employers or to graduate schools during the period between the end of their final grading period and the conferring of degrees may obtain a letter of completion.

University Honors

The University awards degrees with three levels of distinction upon those graduating students who have exhibited exceptional scholastic records. To graduate with honors a student must have achieved a minimum grade point average of 3.00 for all courses completed at the University, and must have earned a minimum of 60 semester credits at the University as upper-class students, or a minimum of 30 semester credits for the associate's degree. Additionally, students' cumulative average for both associate's and bachelor's degrees must fall within the ranges set forth by each college.

University Commencement

Graduation exercises are held once a year in early June. Undergraduates who have completed requirements during the preceding fall semester, who complete degree requirements during the current spring semester, and who anticipate completion of degree requirements during the next immediate summer term are encouraged to attend commencement exercises and their names are listed in the commencement booklet.

Awarding of Certificates

After successful completion of all certificate requirements, including a grade point average of 2.00, a student should submit a completed Petition for the Awarding of a Certificate to the Division of Continuing Education. The petition should be accompanied by an official high school transcript or G.E.D. and a college transcript if the student is planning to transfer a course. Upon verification of a documentation and within 4-6 weeks, the student will be mailed the certificate by U.S. first class mail. The receipt of the certificate will be noted formally on the student's transcript with an award date of October, February, or June.

Financial Assistance and Expenses

The opportunity for an education should not be determined by a person's economic status. As the cost of higher education increases, more students must depend on financial assistance to supplement their financial resources. State and federal loan programs are now subject to legislation which recognizes more fully the financial requirements of the part-time student. Needs-based grants may be provided to students taking as few as one course per semester if enrolled in a degree program.

All students entitled to benefits under federal and state law must:

- have a high school diploma or GED equivalent;
- have completed the application for admission form;
- have declared a major program of study.

Please note that international students *may* (for specific designations under I-688 or I-94) or *may not* (F1, F2, J1, J2, I-688, or G Series) be eligible to receive federal or state financial aid, depending upon their particular visa status. The Office of Immigration and Naturalization, together with the UMass Lowell Financial Aid Office will aid in the determination of this eligibility.

The Office of Financial Aid was established to provide both day and evening students with the financial assistance necessary to reach their educational goals. Located on the second floor of the McGauvran Student Union Building, South Campus, this office is open year-round during regular business hours, Monday through Friday. Extended hours until 6:30 p.m. are also offered several days per week, during both the Fall and Spring terms. Please call (508) 934-4220 to confirm current office hours.

In order to qualify for financial aid, a student must submit copies of Internal Revenue form 1040 as well as a financial aid form, or if a resident of Massachusetts, a Massachusetts financial aid form. This one form, which enables students to be considered for all types of assistance including Stafford Loans (GSL), is available at the UMass Lowell's Financial Aid Office.

Students are urged to apply well in advance of the term for which they wish to be considered for financial aid. To receive aid for the Fall term, applications will be processed beginning January 1, and the Financial Aid Form should be postmarked no later than March 1. All students should be aware that federal regulation requires that in the absence of approved extenuating circumstances, a student who fails to meet the minimum institutional standards in his or her program, following periods of warning and probation, is no longer eligible for any federal financial aid funds.

The following list summarizes federal student assistance programs administered through the UMass Lowell Financial Aid Office. Students may also request a copy of the "Alternative Financing Options" information sheet, available at the Financial Aid Office.

Pell Grant

It is UMass Lowell's policy that all students in need of financial assistance file for the Pell Grant program, since the criteria of this program are the basis for determining student needs. All students, except those who have already received a baccalaureate degree, are eligible to apply. Applications for the grants may be obtained from the Financial Aid Office, federal post offices, and public libraries.

Federal Supplemental Education Opportunity Grant

In conjunction with other forms of financial aid (with priority given to Pell Grant recipients), supplemental grants provide assistance to students of exceptional financial need who would not otherwise be able to consider a college education without attendant indebtedness that would seriously impair future careers.

College Work-Study Program

Under the Work-Study program, a student who meets established financial aid criteria can be assigned part-time employment on campus at not less than minimum wage. Full-time students may work 15 hours per week and up to 40 hours per week during vacation and summer periods. Applications are due March 1 for new students and May 1 for returning students.

The following loan programs are also processed through the UMass Lowell Financial Aid Office, where more information regarding them is also available:

Perkins Loan

A long term, low interest federal loan. Payment begins after borrower ceases to be a student.

Federal Stafford (GSL) Loan

A long term, low interest loan made by private lending institutions upon certification by the Financial Aid Office. Unsubsidized Federal Stafford Loans are available to eligible students regardless of family income.

Parent PLUS Loan

Obtained by parents for students attending eligible programs of study on at least a half-time basis.

Mass Plan Family Education Loan

Designed to assist families that have students attending colleges and universities in Massachusetts; call 1-800-842-1531 for further information.

TERI, Alliance Supplemental Loans, etc.

Students must be credit worthy.

Payment Plan—Academic Management Service

Available to students who have been accepted into a Continuing Education degree or certificate program. A monthly payment plan may be arranged for the fall or spring term for a non-refundable fee, currently \$30 per term, or fall plus spring terms for \$50. (The winter intersession and summer terms are too short in duration for the plan to be administered.) Under this plan, students can budget tuition payments over a period of several months. The appropriate fee will be paid to Continuing Education when the student registers and forwarded to AMS (Academic Management Services). Descriptive brochures and applications are available at the Continuing Education Business Office, or for further information, contact AMS at their toll free number: 1-800-531-4300.

Commonwealth Employees Tuition Remission

Provisions of particular collective bargaining agreements allow employees of the Commonwealth of Massachusetts, and in some cases their dependents, to take Continuing Education courses at a 50% reduction in tuition. Students who might be eligible should consult their personnel director for guidelines. Currently valid Certificates of Eligibility, complete with all necessary signatures of approval, must be presented at the time of registration for classes. Retroactive waivers will not be accepted.

Senior Citizens

Individuals over sixty years of age may attend classes in Continuing Education credit programs tuition-free provided that there are sufficient tuition paying students enrolled to bear the cost of instruction and provided there is space available. Please note that waivers are not retroactive and do not cover registration and other fees.

Veterans Benefits

To be eligible for veterans benefits under federal or state law, students must:

1. submit proof of high school graduation or GED equivalent;
2. complete an application for admission;
3. declare a major program of study or certificate program.

Veterans who are permanent legal residents of Massachusetts for at least one year and were in active service prior to May 5, 1975 or have a campaign medal for Lebanon, Grenada, Panama, or the Persian Gulf will be given a full-tuition waiver. To file, the student must submit with their registration either a Form 10 (available through the Department of Education - War Records) or a copy of DD214, together with proof of residency. In addition, active members of the Armed Forces (Army, Navy, Marine Corps, Air Force, or Coast Guard) stationed and residing in Massachusetts are eligible for a full-tuition waiver.

Veterans who are entitled to financial educational benefits under federal law and are attending the University for the first time must submit appropriate forms to Continuing Education through the Office of Enrollment Services. Forms are available in the Office of Enrollment Services or the local Veterans' Administration Office. Veterans who have not previously used benefits must also submit a DD214.

Tuition and Fee Information

Tuition is priced on the basis of credit hour unless contact hour is different. Tuition is then based on the listed contact hour. Course credit/contact hour information is provided in the Continuing Education Course Bulletin each semester. Tuition and fees are subject to change.

Summer 1994 tuition and fees are as follows:

Registration fee* (credit)	\$25.00
Undergraduate tuition (per credit/contact hour)	\$105.00
Graduate tuition	\$150.00
Late registration fee*	\$10.00
Laboratory fee*	\$45.00
Returned check fee*	\$30.00
Graduation fee (associate's and bachelor's degree)	\$75.00

*Fees are not refunded unless Continuing Education is responsible for cancellations.

Tuition Refund Schedule

Refunds of credit program tuition, if any, are made on the basis of the date and time of receipt of a student's official withdrawal. Any eligibility for tuition refund is based on the academic calendar, not class attendance, and is prorated as follows:

Withdrawal before first class meeting	100%
Before the second class meeting	90%
Before the third class meeting	50%

Payment of Bills

All payments are due at the time students register for classes, unless the student has been processed for the AMS tuition monthly payment plan (see previous page). A student who is in debt to the University at the end of any term or summer session may not register for another term or receive transcripts or grade reports until the balance is paid.

Student Services

The Division of Continuing Education is sensitive to the concerns of the part-time student and encourages students to take advantage of the following services:

Academic Advising

Students who choose to pursue a degree program are assigned an academic advisor. Students are encouraged to arrange an appointment with the program advisor upon admission into a program. The advisor will outline a program of study, taking into consideration previous academic credit. Although the program advisor will assist students, each student must assume responsibility for observing the curriculum requirements and University policies.

New students, transfer students and students not enrolled in degree programs also may obtain academic advising on course selection and Continuing Education programs and policies. Academic advisors are available to talk to students about courses, transfer credit, degree requirements, and other matters of individual concern.

Students who have questions concerning career goals or who are uncertain about the choice of major are encouraged to meet with our career counselor to discuss these concerns.

Career Placement

The services of the Placement Office, located in Southwick Hall, North Campus, are available to Continuing Education students during daytime hours. Services include interview and job marketing workshops, career days, and on-campus recruiting interviews. Students should refer to The Connector (UMass Lowell's day school newspaper) for weekly updates on placement services. The Connector is available at the Office of University Life, North Campus and at the McGauvran Student Union, South Campus.

National Honor Society

The Gamma Delta Chapter of Alpha Sigma Lambda is a national honor society for adult students in Continuing Education. The aim of Alpha Sigma Lambda is to recognize adult students who achieve academic excellence in their course work while performing the many responsibilities associated with their families and careers. Eligibility for membership at UMass Lowell requires that students rank in the top 10% of all students who meet certain academic requirements. Selections for membership are made during each spring semester and students who are invited to become members are inducted into the Society in May. Membership in Alpha Sigma Lambda provides the University with an opportunity to acknowledge the endeavors of outstanding adult students in the Continuing Education program.

Physically and Learning Disabled Student Services

The University is committed to serving all students with disabilities as stipulated by the Rehabilitation Act of 1973 and Americans with Disabilities Act of 1990. A qualified person with a disability means: an individual with a disability who, with or without reasonable modifications to rules, policies or practices, the removal of architectural, communication or transportation barriers, or the provision of auxiliary aids and services, meets the essential eligibility requirements for the receipt of services or the participation in programs or activities provided by a public entity. The federal definition of a disabled person includes any individual who:

1. has a physical or mental impairment which substantially limits one or more of such person's major life activities;
2. has a record of such impairment; or
3. is regarded as having such impairment.

Students must provide documentation of their disability before receiving services. In the case of medical disability, documentation from a physician is appropriate. In the case of a learning disability, documentation must be submitted from one of two sources:

1. Students diagnosed with a learning disability prior to graduation from secondary school may submit the psycho-educational evaluation from a file at the high school. This evaluation must have been made within the last three years.
2. Students diagnosed after high school must submit a psycho-educational evaluation performed by a licensed psychologist or education specialist within three years of request for services. It is the student's responsibility to arrange and pay for all testing necessary to qualify for disabilities services.

To the maximum extent possible, disabled students are integrated into the general student population and are encouraged to resolve problems through the usual channels. Special advising, registration assistance, preferential scheduling, tutoring, readers, and alternative examination procedures are available. It is in the best interest of the student to contact the Division of Continuing Education well in advance of the beginning of a semester so services can be made available in a timely manner.

University Bookstore

The University Bookstore is located in the lower level of the McGauvran Student Union, South Campus, and in the lower level of Pasteur, North Campus. Please check with the Division of Continuing Education or the semester bulletin for times of operation. The Bookstores carry all textbooks and supplies needed for classes. The Bookstores also provide a wide range of imprinted clothing and backpacks, greeting cards, calculators, etc. Purchases at the Bookstores can be made by cash, check, or MasterCard/Visa/Discover.

Academic Computer Center

The Academic Computer Center (ACC) provides computing services for all UMass Lowell students, faculty, and staff. Services include electronic mail, connection to worldwide networks (Internet, NSFnet), a bulletin board service (Videotex), conferencing systems (Cosy and VaxNotes), statistical analysis utilities (Minitab, SAS and SPSS), database management systems (Ingres), computer aided instruction, computer games and many programming languages including Cobol, Fortran, Basic, C, Ada, Pascal and Lisp.

The ACC, located in Olsen Hall, has three terminal rooms with over 100 terminals available for student use. In addition, a number of other buildings also have public terminal rooms: O'Leary Library, Weed Hall, Falmouth Hall and Southwick Hall. The User Services Dept., Olsen 102-104, can assist students in the use of the computers, application packages and programming languages. The ACC Library, Olsen 111, makes available manuals on loan for all of the software supported by the ACC. Finally, the ACC publishes a newsletter twice each semester to update users on current events.

Students enrolled in a computer course with a lab will be assigned a computer account. Other students may receive an account by bringing a student ID card, a note from Continuing Education, or any other proof of matriculation to the Academic Computer Center's Computer Room, Olsen Hall 111 (North Campus) during posted hours of operation.

University Libraries

The University libraries, which consist of the Alumni/Lydon Library (North Campus) and the O'Leary Library (South Campus), include over 370,000 books and periodicals and a large number of non-print materials such as video tapes, films and microforms. The O'Leary Library provides resources in the social sciences, humanities and health areas, and houses the ERIC microfiche collection (Educational Resources Information Center). Music collections and facilities of O'Leary Library include listening stations, audio recordings and over 7,000 music scores. The Alumni/Lydon Library houses collections for engineering, science and business. The University libraries provide inter-library loan services and function as a U.S. Government depository.

The Center for Lowell History (in the Boott Mill Complex, downtown Lowell) contains special collections of the University, including the holdings of the American Association of University Women, Greater Lowell Chapter; Boston and Maine Railroad Historical Society; Lowell Historical Society; Lowell Museum; Manning Family; Middlesex Canal Association; Proprietors of the Locks and Canals on the Merrimack River; University Archives; and a collection of regional histories. Other valuable resources include educational media and New England maps published by the Geological Survey of the U.S. Department of the Interior.

Parking

All students are required to obtain a student parking sticker that allows them to park on campus. Stickers are issued through the University Police when the student presents a validated ID card and vehicle registration. For restrictions on parking, please refer to the semester bulletins.

Student Escort Service

The student escort service is designed to walk students anywhere on campus. The service is in constant radio contact with the University of Massachusetts Police Department. To request an escort any day of the week between 7:00 p.m. and 1:00 a.m., call 934-2960 or 934-2365; 24 hours-a-day, call 934-2394 or 934-2398.

Shuttle Bus, Inter-Campus Transportation

Shuttle buses run continuously between the campuses from 7:15 a.m. through 11:00 p.m. on class days. Detailed schedules are posted around campus and are available at the Office of University Life (North Campus) and the Office of Student Activities and Commuter Services (South Campus).

Students Rights and Responsibilities

Student Status Committee

The Student Status Committee meets approximately once a month and reviews petitions sent to the Division of Continuing Education by students.

Definitions of Academic Dishonesty

Students in the Division of Continuing Education are expected to be honest and to respect ethical standards in meeting these academic assignments and requirements. A student who cheats on an examination or assignment is subject to administrative dismissal.

The following definitions are provided for the information of all students and constitute official notice of prohibited academic practice and behavior.

1. Cheating is defined as 1) misrepresenting academic work which has been done by another as one's own efforts—whether such misrepresentation has been accomplished with or without the permission of the other individual, 2) providing or utilizing prohibited assistance (whether in the nature of a person or a resource) in the performance of assignments and examinations, 3) copying of another person's work or the giving or receiving of information or answers by any means of communication during an examination, 4) utilization of the services of a commercial term paper company, and 5) the unauthorized or fraudulent acquisition and/or use of another's academic property.
2. Plagiarism is defined as 1) direct quotation or word-for-word copying of all or part of the work of another without identification or acknowledgment of the quoted work, 2) extensive use of acknowledged quotation from the work of others which is joined together by a few words or lines of one's own text, and 3) an abbreviated restatement of someone else's analysis or conclusion, however skillfully paraphrased, without acknowledgment that another person's text has been the basis for the recapitulation.

Student Responsibility

It is the student's responsibility to become familiar with all the regulations and procedures required by the academic program being pursued. In no case should students expect waiver or exception to published program requirements by pleading ignorance to the regulation or asserting that an advisor or other authority did not correctly present the information. All students are expected to become familiar with the academic information section of this catalog and the specific program requirements.

Students must pay for University equipment which they have broken or damaged, provided that such breakage does not occur while the student is under direct supervision of the instructor. In some instruction, students are required by law to wear safety glasses or other safety devices. The instructor of such classes will inform students of their obligation to obtain and wear the necessary safety protection.

University Policies

Student Records

The Family Educational Rights and Privacy Act of 1974 (FERPA) assures confidentiality of educational records containing information directly related to a presently enrolled student, a former student or alumni. It also grants to any student currently in attendance, or to a former student, the right of access to inspect or review his or her educational files, records, or data. Students who wish to inspect their records must file a "Right of Access" form with the Office of Enrollment Services. Within ten days of receipt of the right of access form, the Office will notify the student as to when and where the record may be inspected.

The University, according to FERPA, may make public "Directory Information" about a student. Directory Information has been defined by the University to include: name, city and town of residence, university mailbox number, date of birth, previous educational institution(s) attended, major field of study, dates of attendance, awards and honors received, degrees conferred, past and present participation in officially recognized sports and activities, and height/weight of athletic team members. Students who wish to withhold directory information from public distribution must write to the Office of Enrollment Services before the tenth class day of the semester for which non-disclosure is desired.

Educational records concerning individual students may not be released to any individual or agency without written permission of the student; however, Chapter 776 of the Acts of 1975 specifies conditions under which records may be released without permission of the student. These conditions are listed in UMass Lowell's Undergraduate Catalog.

Discrimination and/or Harassment

Federal and state laws require that no student be discriminated against on the basis of age, national origin, race, religion, sex, sexual orientation, or disability, marital, or veteran's status. The Affirmative Action Office, which implements Equal Opportunity/Affirmative Action, is located on the second floor of Dugan Hall (South Campus). The Affirmative Action Office deals with discrimination and harassment complaints and also with the monitoring of actual practice and written policies and procedures, (e.g.: student activities, course offerings, teacher and student attitudes). Sexual harassment of students by faculty, administrators, other employees, or fellow students is a form of sexual discrimination prohibited by Massachusetts Fair Practices Act, Title VII of the 1964 Civil Rights Act, and Title IX.

The University of Massachusetts Lowell will not tolerate behavior, either verbal or physical, by a member of the University community, which leads to sexual harassment of another member of the community. Any student who believes that he or she has been discriminated against or harassed, or who believes that the University is operating in a manner which adversely affects individuals should contact the Affirmative Action Office immediately.

Affirmative Action

The University of Massachusetts Lowell is an Affirmative Action/Equal Opportunity University and does not discriminate on the basis of race, sex, sexual orientation or disability status in its educational programs, activities, or employment programs, activities, or employment policies as required by Title IX of the Education Amendments of 1972 and Section 504 of the Rehabilitation Act of 1973 as amended.

Absences Due to Religious Beliefs

Chapter 375, Acts of 1975 of the Commonwealth of Massachusetts requires recognition of student religious beliefs as noted.

"Any student...who is unable, because of his religious beliefs, to attend classes or to participate in any examination, study, or work requirement on a particular day shall be excused from any such examination or study or work requirements, and shall be provided with an opportunity to make up such examination, study, or work requirement which he may have missed because of such absence on a particular day; provided, however, that such make up examination or work shall not create an unreasonable burden upon such school. No fees of any kind shall be charged by the institution for making available to the said student such opportunity. No adverse or prejudicial effects shall result to any student because of his availing himself of the provisions of this section."

Smoking Policy

This policy has been developed for the purpose of promoting a safe and healthy environment within the University. It is intended to reduce the risks associated with exposure to tobacco smoke while minimizing the inconvenience to smokers. The policy is in conformance with that established by the Executive Office for Administration and Finance, Commonwealth of Massachusetts.

The following are NO SMOKING AREAS:

- any room in which meetings are regularly conducted, or in which a meeting is in progress,
- health service areas,
- classrooms and laboratories (including computer terminal rooms),
- stairwells, hallways, restrooms, and elevators,
- all work and office areas, including private offices,
- food service areas/cafeterias with seating capacity of 75 or less.

Areas Which are to Remain Completely Smoke Free:

North Campus

Alumni Library
Marilyn Evans Lounge
Health Services

South Campus

Durgin Hall
Weed Hall

West Campus

Read Hall

Other

Tully Forum

Designated Smoking Areas

Within these buildings, smoking is allowed only in the areas designated below:

North Campus

Ball

Commuter Lounge

Cumnock

Costello

Engineering

Designated Smoking Areas:

2nd floor alcove, off main hallway adjacent to Engineering and bridge to Olney.

Area behind the TV Lounge.

Foyer, lowest level.

Left side corridor from trophy cases to door adjacent to pool.

See Ball Hall.

(continues...)

Falmouth	Third floor juncture of Falmouth and Kitson in alcove area.
Kitson	See Falmouth.
Pasteur	See Falmouth.
Lydon Library	Staff: Room 107 (staff lounge) and Room 402. Students: Media Services hallway basement level.
Olney	Front lobby.
Olsen	Front lobby.
Pinanski	Front lobby.
Southwick	First floor commuter lounge by vending machines.
<u>South Campus</u>	<u>Designated Smoking Areas:</u>
Dining Hall	Selected tables designated by the Food Service (ARA).
Coburn	Lower level access hallways at rear entrance.
Dugan	Foyer near entrance.
Mahoney	Basement near unused locker room.
O'Leary Library	Staff: Staff lounge, first floor; mezzanine level near room 150; fifth floor room 504. Students: Walkway between O'Leary and McGauvran Student Union.
McGauvran Student Union	Walkway between Student Union and O'Leary Library.
<u>West Campus</u>	<u>Designated Smoking Areas:</u>
Gould	Ground level student lounge (not Econ. Education Ctr.)
Upham	First floor rear area, behind mail boxes.

For buildings that are completely smoke free, receptacles have been placed outside the entrances. Please use them.

Drug and Alcohol Policies

All students at the University of Massachusetts Lowell are expected to abide all Federal, State and local laws, including those regulating the use, possession, sale, distribution, manufacture and cultivation of illicit drugs and alcohol.

In addition, Congress amended Title XII of the Higher Education Act of 1965 by adding a section pertaining to Drug Free Schools and Campuses. Under this new amendment any institution receiving federal funds, including federal student loan programs, must adopt and implement policies to prevent the use of illegal drugs and alcohol by students and employees.

For complete information regarding sanctions, health risks, and referrals/resources for substance-related problems, please refer to the day school's Student Handbook.

Policy Changes

Although the Division of Continuing Education, University of Massachusetts Lowell provides notice concerning changes as is reasonably practical under the circumstances, Continuing Education reserves the right to change requirements, subjects, courses, faculty listings, regulations and other policies stated in this document.

The Division of Continuing Education reserves the right to close a course, cancel a course, alter the scheduled time or faculty listing, change the scheduled night without formal notice, implement new rules and regulations and to make changes of any nature in its program, calendar, procedures and standards, and academic schedule including, without limitation, changes in course content and class schedules.

The Office of Continuing Education periodically releases special announcements or changes from departments, colleges, and the University and, when feasible, directs instructors to read or distribute these in classes.

Administrative policies of a system-wide nature (e.g., admissions policies, tuition, and fees) are subject to change by the Board of Trustees of the University of Massachusetts Lowell and the Massachusetts Board of Regents of Higher Education without advanced notice.

Policy statements, tuition and fee schedules and other information published in this Catalog reflect information which was current when the catalog was published. Such statements and schedules are not intended to be and should not be relied upon as statements of University contractual undertakings. When changes are necessary, the Division of Continuing Education at the University of Massachusetts Lowell exerts reasonable efforts to provide comparable or substantially equivalent instructional services and facilities for those originally designated. However, it assumes no liability for failure to deliver or for delay in delivering such services (including those in support of academic functions or student life) when the causes for such failure or delay are beyond the reasonable control of Continuing Education which causes include, without limitation, the following: power failure, fire, accident, natural disaster, work slowdown and strikes, loss of personnel, changes in funding, and acts of public authorities.

Students acknowledge the above noted reservations by submitting applications for admission and/or by registering for classes.

The University of Massachusetts Lowell is an Affirmative Action/Equal Opportunity University and does not discriminate on the basis of race, sex or handicap status in its educational programs, activities, or employment policies as required by Title IX of the Education Amendments of 1972, Section 504 of the Rehabilitation Act of 1973, as amended, and the Americans with Disabilities Act of 1990.

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Minor in Applied Mathematics: Computer Option

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Norma Clark, B.A.

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Hope Eacrett

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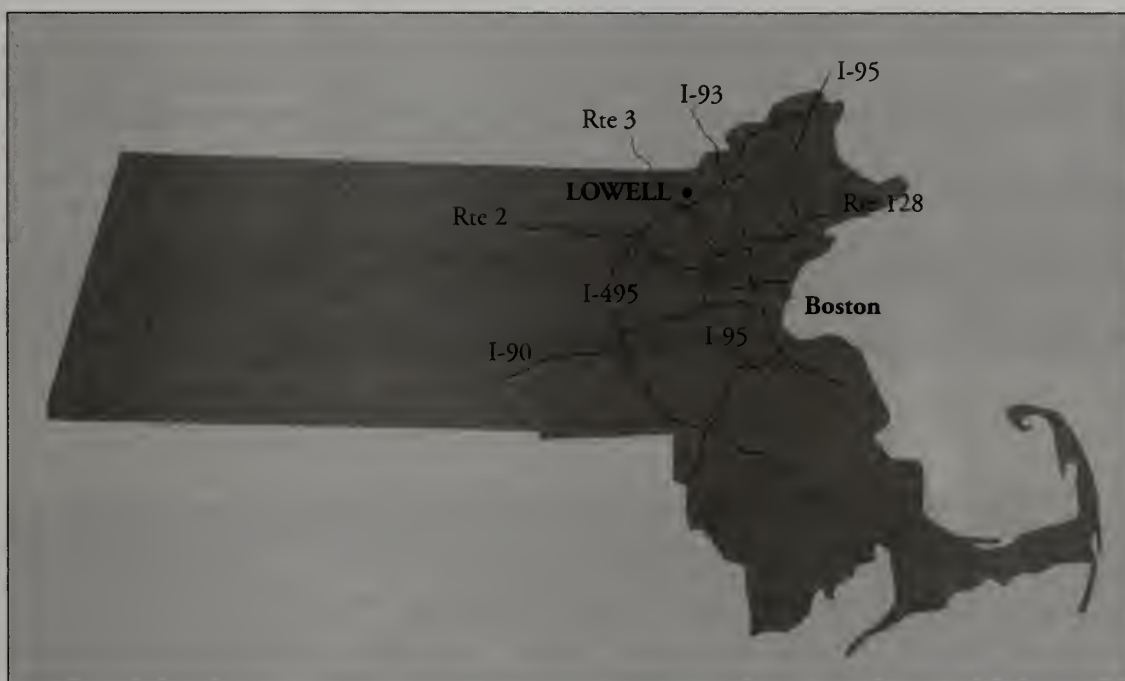
Carol MacInnis

Lyn Misserville

Elizabeth Wesson

Campus Maps

UMass Lowell is located approximately 25 miles northwest of Boston and is easily accessible from Routes 3, 93, 95, and 495. The two major campuses, North and South, lie on opposite sides of the Merrimack River. West Campus, which houses the College of Education, is located in North Chelmsford. Many of the noncredit, community education courses are offered at the Mogan Cultural Center located at 40 French Street in downtown Lowell.



To Lowell and the Lowell Connector...

From Route 495:

Follow 495, north or south towards Lowell, and take Exit 36 to the Lowell Connector.

From Route 93:

Follow Route 93, north or south to Route 495 South and take Exit 36 to the Lowell Connector.

From Route 3:

Follow Route 3, north or south towards Lowell, and take Exit 30N to the Lowell Connector.

From Route 95 (Old Route 128):

Follow Route 95 (128), north or south to the Burlington area and take Route 3 North towards Lowell. Then take Exit 30N to the Lowell Connector.

(continues...)

To North Campus...

From the Lowell Connector take Exit 3, Industrial Avenue. Bear right off the exit ramp, and straight through the lights onto Stevens St. Turn right at the 4th stop sign, onto Middlesex St. Take the 1st left onto Wilder St. and follow through to the river. Turn right onto Pawtucket St. and continue past the 1st bridge and hospital. Turn left at the University Avenue Bridge. Proceed to the 2nd set of lights and take a right onto Riverside St. Parking is on the right, after Olney Hall.

To West Campus...

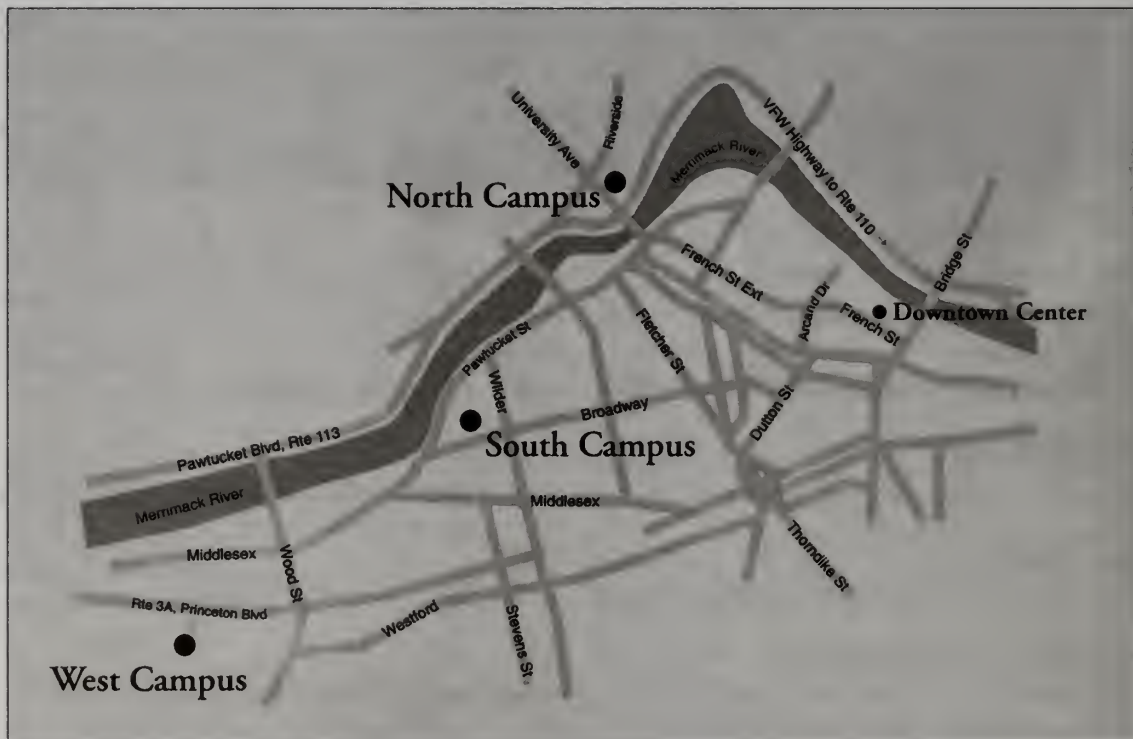
From Route 3 North take Exit 32 (Westford - North Chelmsford Rt. 4). Then take second right off rotary (Rt. 4) and continue to traffic lights. Turn right at the lights (onto Rt. 3A - Princeton Blvd). Travel along the chainlink fence on your right for approximately 1/2 mile and turn right at the blue West Campus sign.

To South Campus...

From the Lowell Connector take Exit 3, Industrial Avenue. Bear right off the exit ramp, and straight through the lights onto Stevens St. Turn right at 4th stop sign, onto Middlesex St. Take the 1st left onto Wilder St. and continue through to the next set of lights. Parking lot is on the corner of Broadway and Wilder streets.

To the Mogan Center...

From the Lowell Connector take Exit 5N, Thorndike St. Bear right off the exit ramp, heading north on Thorndike. At the third set of lights take a right onto Dutton St. Follow Dutton St. to the end. Bear left (keeping the City Hall building on your left) onto Arcand Drive. Follow Arcand Dr. to the next set of lights and take a right. The Mogan Cultural Center is approximately 500 feet on the left (#40 French St.)



North Campus Buildings

- 1 Alumni-Lydon Library
- 2 Ball Hall (BL)
- 3 Costello Gym
- 4 Cumnock Hall
- 5 Engineering (EB)
- 6 Falmouth (FA)
- 7 Health Service
- 8 Kitson (KI)
- 9 Energy Center (EC)
- 10 Olney (OH)
- 11 Olsen (OS)
- 12 Pasteur (PA)
- 13 Research Foundation
- 14 Southwick Hall (SO)
- 15 Wannalancit Mills (WL)

- Residence Halls:
- 16 Bourgeois Hall
 - 17 Donahue Hall
 - 18 Eames Hall
 - 19 Fox Hall/Student Union
 - 20 Leitch Hall
 - 21 Smith Hall

- ♿ Handicap Access
S Shuttle Bus
P Parking



South Campus Buildings

- 1 Allen
- 2 Coburn (CO)
- 3 Dining Hall
- 4 Dugan (DU)
- 5 Durgin (DR)
- 6 Mahoney (MA)
- 7 O'Leary Library
- 8 Power Plant
- 9 McGauvran Student Union
- 10 Weed Hall (WH)

- Residence Halls:
- 11 Concordia Hall
 - 12 Sheehy Hall

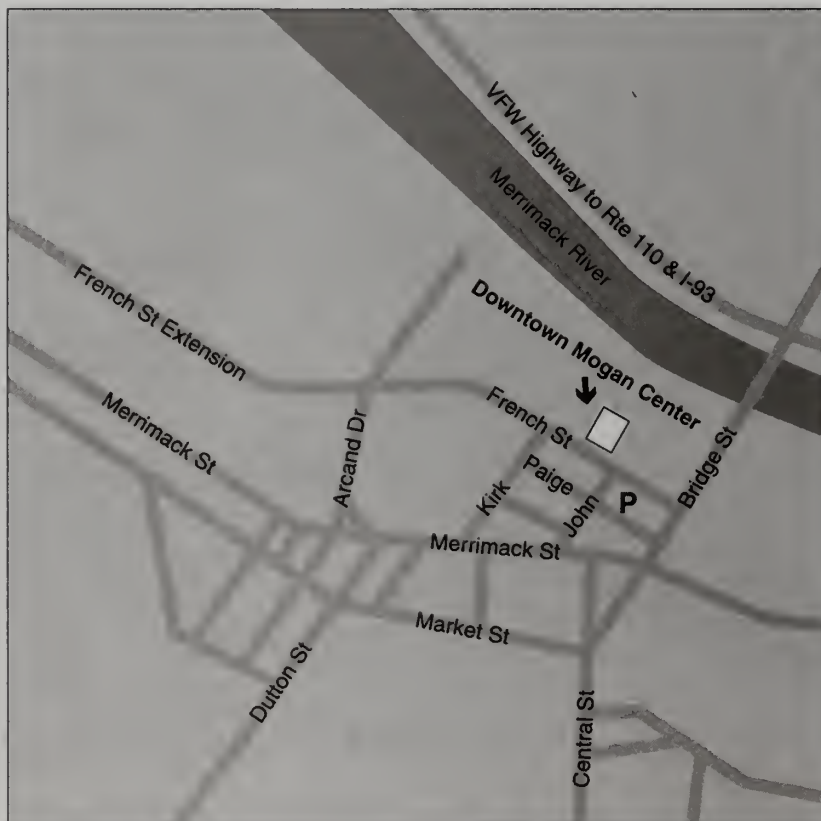
- ♿ Handicap Access
S Shuttle Bus
P Parking





West Campus Buildings

- 1 Rottenberg School
- 2 Upham Hall (UP)
- 3 Read Hall
- 4 Grey House
- 5 Gould Hall
- 6 Demonstration School



Downtown Mogan Center

#40 French Street

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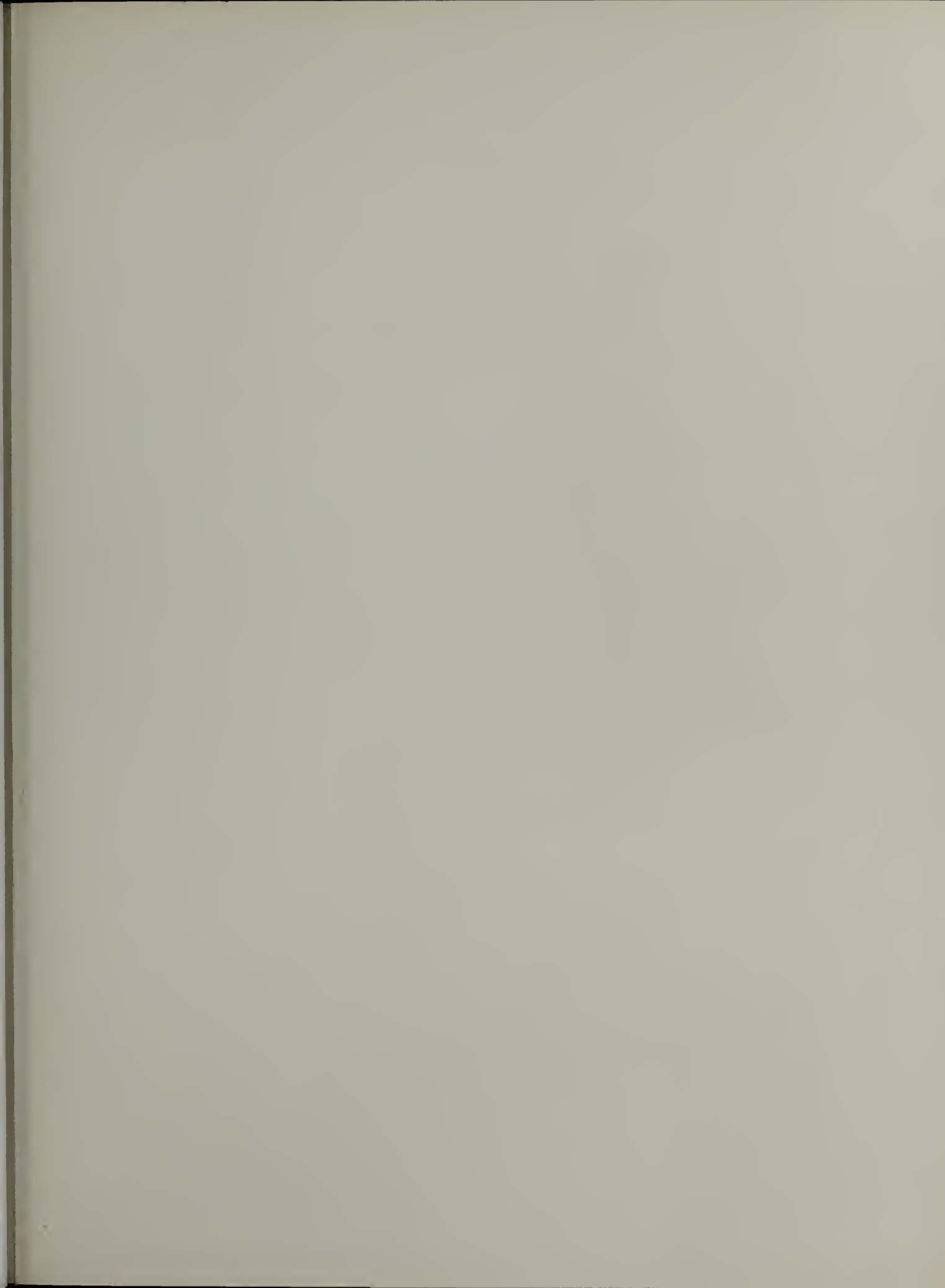
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